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MODELS 673 & 675

Function Modules

FOR 6300 SERIES

Beckman

Operating and Servicing Manual

Electronic Instruments Division

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DOCUMENT CONTROL ADMINISTRATOR

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MODELS 673 & 675

Function Modules

FOR 6300 SERIES

(PREFIX 500)

SERIAL No._____

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INSTRUMENTS, INC.
ELECTRONIC INSTRUMENTS DIVISION
RICHMOND, CALIFORNIA • 94804

MAY 1968

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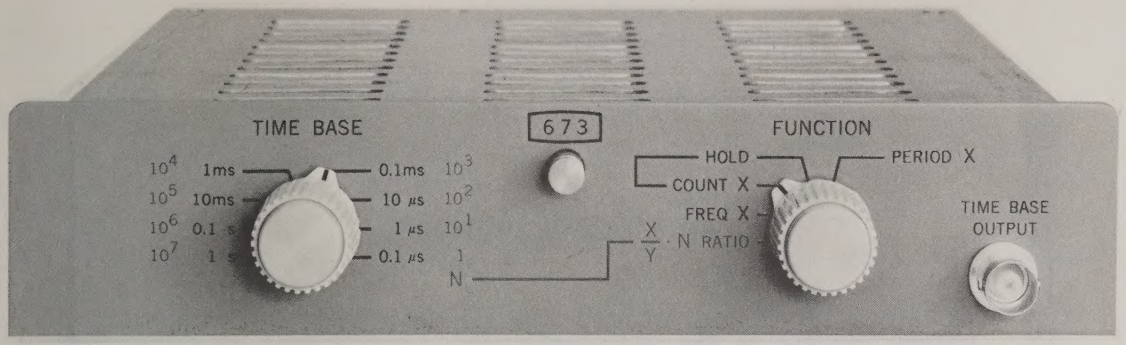


Figure 1-1. Model 673 Function Module

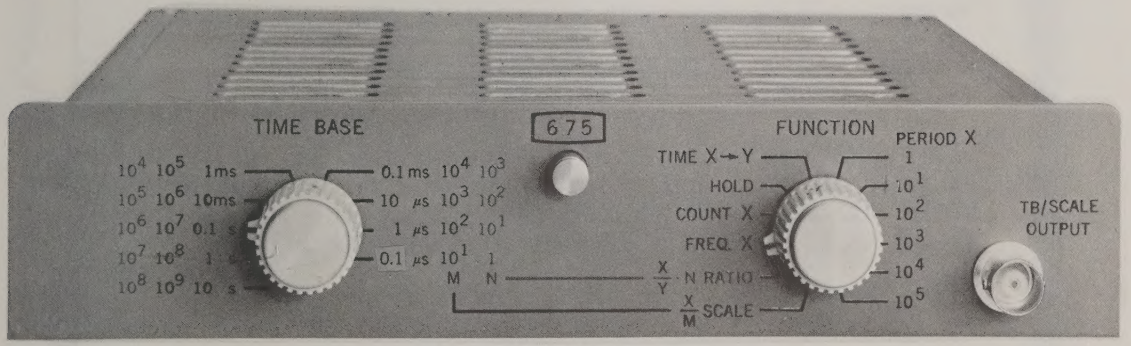


Figure 1-2. Model 675 Function Module

MANUAL REVISIONS

Beckman Instruments is continually striving to provide better quality in its products. As a result, changes are initiated to improve performance and specifications.

Several changes may have been incorporated in your instrument since the manual was last printed. If this is the case, may we impose on you to make these changes to your copy of the manual? All changes are given in the form of addenda, one addendum for each change. They are printed on green-colored paper and inserted, in letter or number sequence, immediately following this page. If a change does not apply to your instrument, please disregard the associated addendum.

PREFIX NUMBERS

The prefix number denotes a generation of manuals. All addenda for a certain prefix number are incorporated in the manual before reprinting and the number increased by one (e.g., "Prefix 500" becomes "Prefix 501").

CONTENTS

			Page
SEC. 1	INTRODUCTION		
	1.1	General	1-1
	1.2	Description of Modules	1-1
	1.3	Specifications	1-1
SEC. 2	INSTALLATION & OPERATION		
	2.1	Unpacking and Handling	2-1
	2.2	Reshipping	2-1
	2.3	Installing the Module	2-1
	2.4	Operating Controls	2-1
		2.4.1 TIME BASE Selector Switch	2-1
		2.4.2 FUNCTION Selector Switch	2-2
		2.4.3 Invalid Settings	2-4
	2.5	TB/SCALE OUTPUT Connector	2-4
	2.6	Operation	2-4
		2.6.1 Operation Test	2-5
		2.6.2 Random Accumulation	2-5
		2.6.3 Frequency Measurement	2-5
		2.6.4 Period and Multiple Period Measurements	2-6
		2.6.5 Time Interval Measurement	2-6
		2.6.6 Frequency Ratio Measurement	2-6
		2.6.7 Frequency Scaling	2-7
		2.6.8 Frequency-Count (Scan)	2-7
SEC. 3	PRINCIPLES OF OPERATION		
	3.1	General	3-1
	3.2	Block Diagram Description - Model 673	3-1
		3.2.1 Signal Select Logic Circuits	3-1
		3.2.2 Decimal Counting Units	3-1
		3.2.3 Control Logic	3-3
		3.2.4 Functional Description	3-3
	3.3	Block Diagram Description - Model 675	3-4
		3.3.1 Multiple Periods	3-5
		3.3.2 Time Interval Measurements	3-5
		3.3.3 Frequency Scaling	3-7
	3.4	Integrated Circuit Logic	3-7
		3.4.1 Resistor-Transistor Logic Gate (RTL)	3-7
		3.4.2 Diode-Transistor Logic Gate (DTL)	3-8

continued. . .

			Page
	3.4.3	Five-Input DTL Gate	3-8
	3.4.4	Transistor-Transistor Logic Gate (TTL)	3-8
	3.4.5	Buffer Amplifiers	3-8
	3.4.6	Decimal Counting Unit	3-10
	3.4.7	BCD-to-Decimal Decoder/Driver	3-10
3.5		Detailed Logic Description	3-12
	3.5.1	Time Base Selection	3-12
	3.5.2	HOLD Function	3-12
	3.5.3	COUNT X Function	3-12
	3.5.4	$\frac{X}{Y}\cdot N$ RATIO Function	3-13
	3.5.5	FREQ. X Function	3-13
	3.5.6	$\frac{X}{M}$ SCALE Function	3-13
	3.5.7	TIME X→Y Function	3-13
	3.5.8	PERIOD X and Multiple Period Averaging	3-13
	3.5.9	Timing Diagram - Signals vs. Function	3-14

SEC. 4 MAINTENANCE

	4.1	General	4-1
	4.2	Preparing the Instrument for Troubleshooting	4-1
	4.3	Adjustments	4-1
	4.4	Troubleshooting Aids	4-1

SEC. 5 DIAGRAMS AND PARTS LISTS

	Dwg. No.	Page
Model 673 EPUT Board Assembly Diagram	D435190	5-2
Model 673 EPUT Board Assembly Parts List		5-3
Model 675 BUCAT Function Board Assembly Diagram	D435220	5-4
Model 675 BUCAT Function Board Assembly Parts List		5-5
Model 673 Logic Diagram	D435284	5-6
Model 675 Logic Diagram	D435779	5-7
Model 673 EPUT Mechanical and Wired Assembly Diagram	D435282	5-8
Model 673 EPUT Mechanical and Wired Assembly Parts List		5-9
Model 675 BUCAT Mechanical and Wired Assembly Diagram	D435376	5-10
Model 675 BUCAT Mechanical & Wired Assembly Parts List		5-11
Model 673 EPUT Final Assembly Diagram	D435260	5-12
Model 675 BUCAT Final Assembly Diagram	D435270	5-13

ILLUSTRATIONS

Figure		Page
1-1	Model 673 Function Module	Frontispiece
1-2	Model 675 Function Module	Frontispiece
2-1	Model 675 Operating Controls	2-2
3-1	Model 673 Function Module Block Diagram	3-2
3-2	Model 675 Function Module Block Diagram	3-6
3-3	RTL Gate Logic	3-8
3-4	DTL Gate Logic	3-9
3-5	Five-Input DTL Gates	3-9
3-6	Two-Input TTL Gates	3-10
3-7	Buffer Amplifiers	3-10
3-8	Decimal Counting Unit (DCU)	3-11
3-9	BCD-to-Decimal Decoder/Driver	3-11
3-10	Timing Diagram	3-15
4-1	Model 673 Simplified Logic-Block Diagram	4-2
4-2	Model 675 Simplified Logic-Block Diagram	4-2
4-3	Top View of Model 675 without Cover	4-3

TABLES

Table		
1-1	Specifications (Model 673 and 675)	1-1
2-1	TIME BASE Switch vs. FUNCTION Switch (Model 675)	2-3
2-2	Count Indications for 10 MHz Test	2-5

SECTION 1
INTRODUCTION

1.1 GENERAL

This instruction manual provides operating and servicing instructions for the Beckman Models 673 and 675 Function Modules. These modules are used in the 6300 Series Counting Units to attain the following measurements:

- Random event counting.
- Frequency.
- Frequency ratio.
- Multiple ratio.
- Period.
- Multiple periods.
- Frequency scaling.
- Time interval.

The first four measurements listed above can be performed by Model 673; all of the above measurements can be performed by Model 675. These Function Modules are compatible with Models 682, 683, and 685 Input Modules for frequency coverage of 0Hz to 20 MHz, or 0 Hz to 200 MHz.

1.2 DESCRIPTION OF MODULES

Models 673 and 675 are shown in Figures 1-1 and 1-2, respectively, (frontispiece). The modules are 7-3/4 inches wide, 1-5/8 inches high, and 7 inches deep. Controls are on the front panel, and consist of the TIME BASE and FUNCTION selector switches. The TIME BASE OUTPUT (TB/SCALE OUTPUT in Model 675) is available at a BNC connector, also on the front panel.

The Model 673 Function Module is similar to Model 675. The principal difference is in the coverage afforded by the FUNCTION and TIME BASE selector switches. Model 673 TIME BASE ranges from 0.1 microsecond to 1.0 second; Model 675 ranges from 0.1 microsecond to 10.0 seconds. Model 673 FUNCTION switch has five positions; Model 675 has twelve. The various positions of the TIME BASE and FUNCTION switches are described in detail in Section 2 of this manual.

All circuits are contained on a single printed-circuit board, which is housed in the rectangular enclosure. Access to the components' side of the board is gained by removing the top cover. A top view without the cover is shown in Section 4 (Figure 4-3). Removing the bottom cover exposes the wiring side of the printed-circuit board. A multi-pin connector at the rear of the module accommodates all signal flow between the module and the Counting Unit.

NOTE

Power is supplied by a Model 6300 Series Counting Unit.

1.3 SPECIFICATIONS (Both Models)

Specifications for both Function Modules are given in Table 1-1.

Table 1-1. Specifications (Models 673 and 675)

	Model 673	Model 675
Frequency Measurements		
Gate Time:	0.1 μs to 1 s in decade steps.	0.1 μs to 10 s in decade steps.
Reads In:	Hz, kHz, and MHz.	Hz, kHz, and MHz.

continued. . .

Table 1-1. Specifications (Models 673 and 675) - continued

	Model 673	Model 675
Frequency-Count (Scan)	Counts events by manually extending time base to any multiple.	
Period Measurements		
Measures:	0.1 μs to 10^6, 10^7, or 10^8 s with Models 6360, 6370, and 6380, respectively. (Minimum START/STOP time 0.1 μs.)	
Timing Units:	0.1 μs to 1 s in decade steps.	0.1 μs to 10 s in decade steps.
Multiple Period Average:		1 to 10^5 periods in decade steps.
Reads In:	s, ms, μs	s, ms, μs
Ratio Measurement		
Measures:	Channel X/Channel Y	Channel X/Channel Y
Frequency Counted:	With Model 683: 0 to 20 MHz (both X and Y). With Model 685: 0 to 200 MHz (X only; Y is 0 to 20 MHz).	
Multiple Ratio		
Measures:	Same as single ratio.	Same as single ratio.
Frequency Counted:	Same as single ratio.	Same as single ratio.
Ratio Averaged:	1 to 10^7 in decade steps.	1 to 10^8 in decade steps.
Count Measurements		
Count/Hold:	With Models 682 or 683: Counts events spaced as close as 50 ns. With Model 685: Counts events spaced as close as 5 ns.	
Accuracy		
Frequency:	±1 count, ± time base accuracy, ± oscillator stability.	
Single Period:	±0.1% for signals with 50 db signal-to-noise ratio; ±1 count ± oscillator stability.	
Multiple Period and Multiple Ratio	0.1% ÷ decade multiple selected, ±1 count ± oscillator stability.	
Output Signals		
Time Base Output:	0.5 to 3.0 volt pulses from 100Ω source.	
Time Interval Measurement		
Timing Units:		0.1 μs to 10 s in decade steps.
Reads In:		s, ms, and μs.
Scale Function		
Scaling Factor:		10 to 10^9 in decade steps.
Frequency Scaled:		With Models 682 and 683: 0 to 20 MHz.
Output Amplitude:		+0.5 to +3.0 volt pulses.
Source Impedance:		100Ω.
Dimensions	Approximately 7-3/4" wide, 1-5/8" high, and 7" deep.	
Weight	Approximately 1-3/4 pounds.	

SECTION 2
INSTALLATION & OPERATION

2.1 UNPACKING AND HANDLING

The Beckman Models 673 and 675 Function Modules are thoroughly tested and inspected, then carefully packed before shipment. The units should be unpacked with the care due any precision instrument. If the package shows it has been dropped or handled roughly, return it to the carrier unopened.

Remove the unit from the shipping container, being careful not to scar or damage the unit. Make a complete visual inspection of the equipment; check that the switches operate mechanically. Report any damage immediately to Beckman Instruments, Inc., Electronic Instruments Division.

2.2 RESHIPPING

Should it become necessary to return the unit to the factory for any reason, follow these packing instructions:

1) Wrap the unit in polyethylene sheeting, sealing all sides.

2) Punch small air holes in the sheeting.

3) Wrap the unit in rubberized hair and pack in a carton, preferably in the original shipping container.

4) Seal the carton and mark it clearly: "FRAGILE - HANDLE WITH CARE".

2.3 INSTALLING THE MODULE

The Function Module occupies the top right-hand slot of the Counting Unit. The module should slide easily and mate with the connector at the rear of the slot. To install the module, push it gently until the back of its panel is flush against the front panel of the Counting Unit. Then push the locking mechanism on the top center of the unit; a faint click should be heard, and the locking mechanism remains receded from its former position. To remove the module, simply push in the locking mechanism and release it; then pull out the module.

2.4 OPERATING CONTROLS

The operating controls of Models 673 and 675 Function Modules are on the front panel. Figure 2-1 is a front panel view of Model 675. For both units, these consist of the TIME BASE and FUNCTION selector switches. Because of the similarity between the two units, only the switches of Model 675 are described. The function of both units is identical for corresponding switch positions. In the text, switches and switch positions are called out as they appear on the equipment; for example, set the FUNCTION selector switch to the FREQ. X position.

2.4.1 TIME BASE Selector Switch

The TIME BASE selector switch provides the means of selecting the gate period for making the frequency measurements; it provides timing pulses at various rates for making period and time interval measurements; it selects scale factors for scaling; and it selects multiplier factors for making the multiple ratio measurements.

Selections ranging from 0.1 microsecond to 10 seconds in decade steps are provided. These positions are used for frequency, period, and time interval measurements. The smaller the time unit chosen, the greater the resolution for period and time interval measurements.

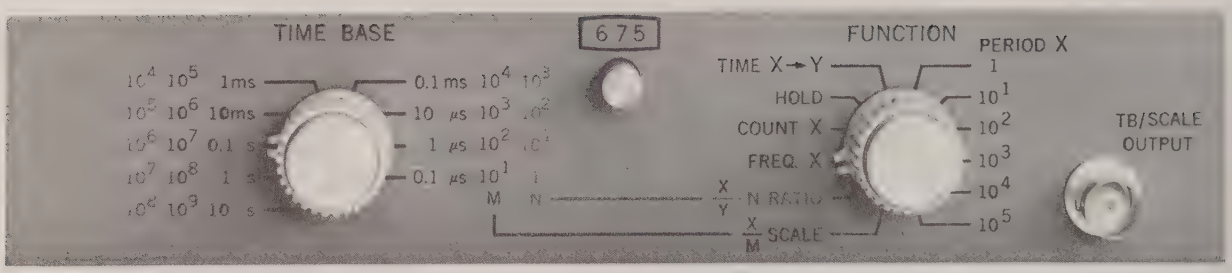


Figure 2-1. Model 675 Operating Controls

Scaling factors from 10 to 10^9 in decade steps are provided. The multiplier factors used in multiple ratio measurements range from 1 to 10^8.

For each setting of the TIME BASE selector switch, an appropriate legend and an illuminated decimal point appear on the in-line display of the Counting Unit. The decimal point is automatically positioned for different TIME BASE selections. Table 2-1 gives the legend and decimal point position which can be expected for each combination of the TIME BASE and FUNCTION selector switches. Incompatible settings are displayed as CHANGE TIME BASE (see paragraph 2.4.3).

2.4.2 FUNCTION Selector Switch

The FUNCTION selector is a 12-position rotary switch used for selecting the operating mode of the instrument. The twelve operating modes are: $\frac{X}{M}$ SCALE, $\frac{X}{Y}$ N RATIO, FREQ. X, COUNT X, HOLD, TIME X→Y, PERIOD X 1, PERIOD X 10^1, PERIOD X 10^2, PERIOD X 10^3, PERIOD X 10^4, and PERIOD X 10^5.

In the $\frac{X}{M}$ SCALE operating mode, the frequency of the signal at the X channel is divided by a factor M. The factor M is selected by the TIME BASE selector; it ranges from 10^1 to 10^9 in decade steps. The scaled frequency is not displayed on the readout; however, it is available at the TB/SCALE OUTPUT Connector.

With the FUNCTION selector switch in the $\frac{X}{Y}$ N RATIO position, the instrument measures the ratio of frequency at the X channel to the frequency at the Y channel, and multiplies this ratio by a factor N. The factor N is selected by the TIME BASE selector in decade steps from 1 to 10^8.

In the FREQ. X mode of operation, the instrument counts events at the X channel in accordance with the setting of the TIME BASE selector switch. The gate period selected by the TIME BASE selector for frequency measurements is available in decade steps from 1 microsecond to 10 seconds.

In the COUNT X mode of operation, the instrument counts events at the X channel. In this mode, the control gate period is manually selected. The mode is typically selected by switching from HOLD to COUNT X to start the control gate period, and then switching back to HOLD to terminate the period.

Table 2-1. TIME BASE Switch vs. FUNCTION Switch (Model 675)

FUNCTION Switch Position	TIME BASE Switch Position								
	10^8 10^9 10s	10^7 10^8 1s	10^6 10^7 0.1s	10^5 10^6 10ms	10^4 10^5 1ms	0.1ms 10^4 10^3	10μs 10^3 10^2	1μs 10^2 10^1	0.1μs 10^1 1
SCALE									
Legend	None	None	None	None	None	None	None	None	None
Decimal Pt.	None	None	None	None	None	None	None	None	None
RATIO									
Legend	Change	None	None	None	None	None	None	None	None
Decimal Pt.	T. B.	8	7	6	5	4	3	2	1
FREQ X									
Legend	Hz	Hz	kHz	kHz	kHz	MHz	MHz	MHz	Change
Decimal Pt.	2	1	3	2	1	3	2	1	T. B.
COUNT X									
Legend	None	None	None	None	None	None	None	None	None
Decimal Pt.	None	None	None	None	None	None	None	None	None
HOLD									
Legend	None	None	None	None	None	None	None	None	None
Decimal Pt.	None	None	None	None	None	None	None	None	None
TIME X→Y									
Legend	Change	s	s	s	ms	ms	ms	μs	μs
Decimal Pt.	T. B.	1	2	3	1	2	3	1	2
PERIOD X1									
Legend	Change	s	s	s	ms	ms	ms	μs	μs
Decimal Pt.	T. B.	1	2	3	1	2	3	1	2
PERIOD X10									
Legend	Change	s	s	s	ms	ms	ms	μs	μs
Decimal Pt.	T. B.	2	3	4	2	3	4	2	3
PERIOD X10^2									
Legend	Change	s	s	s	ms	ms	ms	μs	μs
Decimal Pt.	T. B.	3	4	5	3	4	5	3	4
PERIOD X 10^3									
Legend	Change	s	s	s	ms	ms	ms	μs	μs
Decimal Pt.	T. B.	4	5	6	4	5	6	4	5
PERIOD X 10^4									
Legend	Change	s	s	s	ms	ms	ms	μs	μs
Decimal Pt.	T. B.	5	6	7	5	6	7	5	6
PERIOD X 10^5									
Legend	Change	s	s	s	ms	ms	ms	μs	μs
Decimal Pt.	T. B.	6	7	8	6	7	8	6	7

The HOLD operating mode prevents the instrument from counting. Any count that appears on the display of the Counting Unit remains static until a different operating mode is selected, or until the instrument is manually reset.

In the FREQ. X or COUNT X (Scan) modes of operation, the time base may be extended to any multiple of 1 second or 10 seconds by initiating a gate opening in the FREQ. X mode and switching to the COUNT X position for just under the desired time and then returning the FUNCTION switch to the FREQ. X mode.

With the FUNCTION selector switch in the TIME X→Y position, the instrument measures the time interval between the occurrence of an event at the X channel and a subsequent event at the Y channel. The time units for making this measurement are selected by the TIME BASE selector switch in decade steps from 0.1 microsecond to 10 seconds.

In the PERIOD X 1 mode of operation, the instrument measures the time interval between any two consecutive events at the X channel. This position can be selected to evaluate cyclic waveform period, pulse width, or pulse separation. These measurements can be made with greater accuracy by selecting any of the other PERIOD X positions (10^1 through 10^5). In these positions, the instrument measures continuously for the number of periods selected, and then averages the count.

2.4.3 Invalid Settings

Certain combinations of the FUNCTION and TIME BASE selector switches cause the CHANGE TIME BASE instruction to light on the display of the Counting Unit. These combinations are as follows: PERIOD X (1 through 10^5) and 10 s, FREQ. X and 0.1 μs, and TIME X→Y and 10 s (see Table 2-1). The instrument cannot be used with the 0.1 microsecond time base for frequency measurements because of the instrument resolution. However, measurements of PERIOD and TIME interval can be made at 10 s; but the CHANGE TIME BASE instruction comes on because there is no place for the decimal. The reading will be seconds X 10.

2.5 TB/SCALE OUTPUT CONNECTOR

The time base frequency selected by the TIME BASE selector is available at the TB/SCALE OUTPUT connector (TIME BASE OUTPUT in Model 673) in all positions of the FUNCTION selector, except RATIO and SCALE. The frequency for any setting of the TIME BASE selector is the reciprocal of the time unit selected.

When the FUNCTION switch is in RATIO, the signal at the TB/SCALE OUTPUT connector is the frequency at the Y channel divided by a factor N, which is selected by the TIME BASE selector switch. With the FUNCTION switch in SCALE, the frequency at the X channel is divided by a factor M, which ranges from 10^1 to 10^9.

2.6 OPERATION

Operation of the 6300 Series Counting Units is largely a matter of making the proper selections and adjustments at the Function and Input Modules. For any specific measurement, the manner in which the controls of the Input Module are set depends upon the settings of the selector switches of the Function Module, and vice versa. For this reason, the operator is urged to become familiar with the operation of all the controls on both units before operating the instrument.

For all measurements, because of the wide variety of input signals accepted by the instrument,

it is important that all signals be conditioned for waveform and voltage level before they enter the counting circuits. This function of obtaining a suitable signal is achieved by the TRIGGER, ATTEN, and SLOPE controls of the Input Module. These controls and their use is described in the instruction manual for the Input Module.

2.6.1 Operation Test

Use the following procedure to test the instrument for proper operation. This test can be performed each time before using the equipment. If the unit has just been energized, allow one hour warm-up for the crystal oscillator to stabilize.

1) Set the X ATTEN on the Input Module to the TEST position.

2) Set the FUNCTION selector to FREQ. X.

3) Turn the POWER switch to ON and rotate the DISPLAY TIME control on the Counting Unit to MIN.

4) Adjust the X TRIGGER control as stated in the instruction manual for the Input Module.

5) Move the TIME BASE selector switch to each position (except 0.1 μs) and compare the indication on the display with the values given in Table 2-2. The count indications should be within ±1 count of the values stated.

Table 2-2. Count Indications for 10 MHz Test

Time Base	Reading	Unit
1.0 μs	00000010.	MHz
10.0 μs	0000010.0	MHz
0.1 ms	000010.00	MHz
1.0 ms	00010000.	kHz
10.0 ms	0010000.0	kHz
0.1 s	010000.00	kHz
1.0 s	10000000.	Hz
10.0 s	0000000.0	Hz

6) Set the Y ATTEN switch on the Input Module to the TEST position.

7) Adjust the Y TRIGGER control as stated in the instruction manual for the Input Module.

8) Set the FUNCTION selector switch to $\frac{X}{Y}$ N RATIO.

9) Move the TIME BASE selector to each multiplier (N) position. The display should indicate the value of the multiplier, with the decimal point correctly positioned. For example, if N = 1, the display should be 00000001; if N = 10^3 the display should be 00001.000.

2.6.2 Random Accumulation

With the FUNCTION selector at COUNT X, the instrument counts events at the X channel INPUT connector. Proceed as follows to make the measurement:

1) Adjust the Input Module controls as stated in the respective instruction manual.

2) Set the FUNCTION selector to HOLD.

3) Momentarily press the RESET pushbutton; observe that the display resets to zero.

4) Turn the FUNCTION selector to the COUNT X position. This begins the counting action. Turn the FUNCTION selector to HOLD to stop the counting.

5) Read the count indication. To continue counting without erasing the previous indication, turn the FUNCTION selector back to COUNT X.

2.6.3 Frequency Measurement

With the FUNCTION selector in the FREQ. X position, the instrument counts events at the X channel INPUT connector for the unit of time selected by the TIME BASE selector. Proceed as follows to measure frequency:

1) Adjust the input controls as stated in the instruction manual for the Input Module.

2) Set the FUNCTION selector to FREQ. X.

3) Set the TIME BASE selector to the time interval over which the events are to be counted. A longer time base increases the number of digits displayed, thus increasing measurement accuracy.

4) Adjust the DISPLAY TIME control for a convenient reading or recording rate.

5) The indication on the display is a direct measurement of frequency, including decimal position and measurement unit.

2.6.4 Period and Multiple Period Measurements

With the FUNCTION selector in the PERIOD X positions, the instrument measures the time interval between consecutive events at the X channel INPUT connector. This permits measuring the period of a cyclical waveform, the width of a pulse, or the separation of pulses. Proceed as follows to measure period:

1) Adjust the input controls as stated in the instruction manual for the Input Module.

2) For single period measurements, set the FUNCTION selector to the PERIOD X1 position. For multiple period measurements, set the FUNCTION switch to the PERIOD X position that provides the desired multiplying factor (between 10^1 and 10^5).

3) Set the SLOPE switches of the Input Module as follows:

   a) To measure the period of a periodic waveform, set both SLOPE switches to "+" or both to "-".

   b) To measure the width of a positive waveform, set the START SLOPE switch to "+" and the STOP SLOPE switch to "-".

   c) To measure the width of a negative waveform, set the START SLOPE switch to "-" and the STOP SLOPE switch to "+".

   d) To measure separation of positive pulses, set the START SLOPE switch to "-" and the STOP SLOPE switch to "+". Use the reverse settings for negative pulses.

4) Observe with an oscilloscope the GATE MARKERS on the rear panel of the Counting Unit to determine the triggering point or time interval at which counting occurs. The GATE MARKERS can be compared to the input signal and the TRIGGER control adjusted to start the measurement at any point along the input waveform.

5) Set the TIME BASE selector switch for a convenient time unit. In general, smaller time units give greater resolution.

6) Adjust the DISPLAY TIME control for a convenient reading or recording rate.

7) The display gives a direct indication of count, unit of measurement, and decimal point.

2.6.5 Time Interval Measurement

With the FUNCTION selector in the TIME X→Y position, the instrument measures the time interval or elapsed time between an event at the X INPUT and a subsequent event at the Y INPUT. Proceed as follows to make this measurement:

1) Adjust the input controls as stated in the instruction manual for the Input Module.

2) Set the FUNCTION selector switch to the TIME X→Y position.

3) Set the SLOPE switches to correspond to the polarity of the signals used to start and stop the measurement.

4) As with the period measurements, the TIME BASE selector switch selects the unit of measurement. Set the switch for the desired resolution. Smaller time units give greater resolution.

5) Adjust the DISPLAY TIME control for a convenient reading or recording rate.

6) The display gives a direct indication of count, unit of measurement, and decimal point.

2.6.6 Frequency Ratio Measurement

With the FUNCTION switch in the $\frac{X}{Y}$·N RATIO position, the instrument counts the number of events that occur at the X channel during a specified time interval at the Y INPUT. Proceed as follows to make this measurement:

1) Connect the higher frequency to the X INPUT; adjust the input controls as stated in the instruction manual for the Input Module.

2) Set the FUNCTION selector switch to the $\frac{X}{Y}$. N RATIO position.

3) Turn the TIME BASE selector switch to the desired value of N (from 1 to 10^8). A preliminary test may be required to determine the multiplier that gives the best results.

4) Set both SLOPE switches to "+" or both to "-".

5) Adjust the DISPLAY TIME control for a convenient reading or recording rate.

6) The display indicates the $\frac{X}{Y}$. N RATIO directly. Since ratio is dimensionless, no measurement unit is given. The decimal gives a true ratio of $\frac{X}{Y}$. N regardless of multiplier.

2.6.7 Frequency Scaling

With the FUNCTION selector switch in the $\frac{X}{M}$ SCALE position, the instrument divides the signal at the X channel by a factor M and delivers the scaled frequency to the TB/SCALE OUTPUT connector. Proceed as follows:

1) Adjust the input controls as stated in the instruction manual for the Input Module.

2) Set the FUNCTION switch to the $\frac{X}{Y}$ N RATIO position.

3) Momentarily press the RESET pushbutton.

4) Turn the FUNCTION switch to the $\frac{X}{M}$ SCALE position.

5) Turn the TIME BASE selector switch to the desired value of M.

6) Obtain the scaled frequency at the TB/SCALE OUTPUT connector. The scaled frequency is not displayed on the readout. For this mode, the instrument is put in FOLLOW and it accumulates the X INPUT events.

2.6.8 Frequency-Count (Scan)

In this mode of operation the instrument counts events during a manually controlled multiple of the time base setting. Proceed as follows:

1) Adjust the input controls as stated in the instruction manual for the Input Module.

2) Set the FUNCTION selector to FREQ. X.

3) Set the TIME BASE to either the 1s or 10s position.

4) Turn the DISPLAY TIME control to MAX.

5) Press the RESET button.

6) Quickly turn FUNCTION switch to the COUNT position.

7) Begin timing the desired number of one or ten second intervals.

8) About halfway through the last timing period, turn the FUNCTION switch back to the FREQ. X position.

9) The display will remain for approximately 10 seconds.

10) To calculate the frequency in Hz, divide the count indication by the total counting interval in seconds.

SECTION 3
PRINCIPLES OF OPERATION

3.1 GENERAL

The theory of operation of Models 673 and 675 Function Modules is described in this section. The discussion, presented in three parts, includes a block diagram description of each unit, integrated-circuit logic descriptions, and a detailed logic description of Model 675.

For the block diagram description, the circuits have been grouped according to function, and their operation is described as it pertains to the various modes of operation. Significant timing and control signals are described in terms of how they govern the sequence of operations. Their point of origin and changes that occur to the signals are discussed from a functional viewpoint, rather than in terms of specific logic level or electrical changes. The object is to show the overall operation of the instrument and provide the background for the more detailed logic descriptions.

In the discussion of integrated circuits, emphasis has been placed on the circuit's logic operation. Thus, input and output logic states are given for each element for all possible logic conditions. From this, the relationship between input and outputs is quickly determined when the integrated circuits are interconnected, or when they are used with other logic elements.

The detailed logic description is an elaboration of the block diagram description. Each functional section is described in sufficient detail that all significant waveforms are covered. For this equipment, a better understanding is gained by considering the time relationships that exist between signals, than by considering most other parameters of the signals.

A timing diagram showing signals versus function is given in Figure 3-10. Actual photographs of waveforms are shown in Table 4-1 of the Models 6360, 6370, and 6380 instruction manual.

3.2 BLOCK DIAGRAM DESCRIPTION– MODEL 673

Model 673 Function Module contains the select and control logic circuits that enable the Series 6300 Counting Units to totalize counts, and to measure frequency, frequency ratio, and period.

The module receives the 10 MHz output of the frequency multiplier in the Counting Unit, and the X and Y channel output signal of the Input Module. It produces signals to position the decimal point and illuminate the legend in the display. It generates accurately controlled Start and Stop signals that go to the Counting Unit, and it selects the time base (TB).

3.2.1 Signal Select Logic Circuits

Figure 3-1 is a block diagram of the Model 673 Function Module. The input signals, applied to NAND gates of the select logic circuits, are enabled or inhibited by the mode select circuit, depending on the measurement to be made. For frequency ratio measurements, only the Y channel signal passes through to the decimal counting unit (DCU). For the other measurements (frequency, period, and random-event counting), the Y channel signal is inhibited and the 10 MHz signal triggers the DCU.

3.2.2 Decimal Counting Units

There are seven identical decimal counting units in the Model 673 Function Module. The DCU's

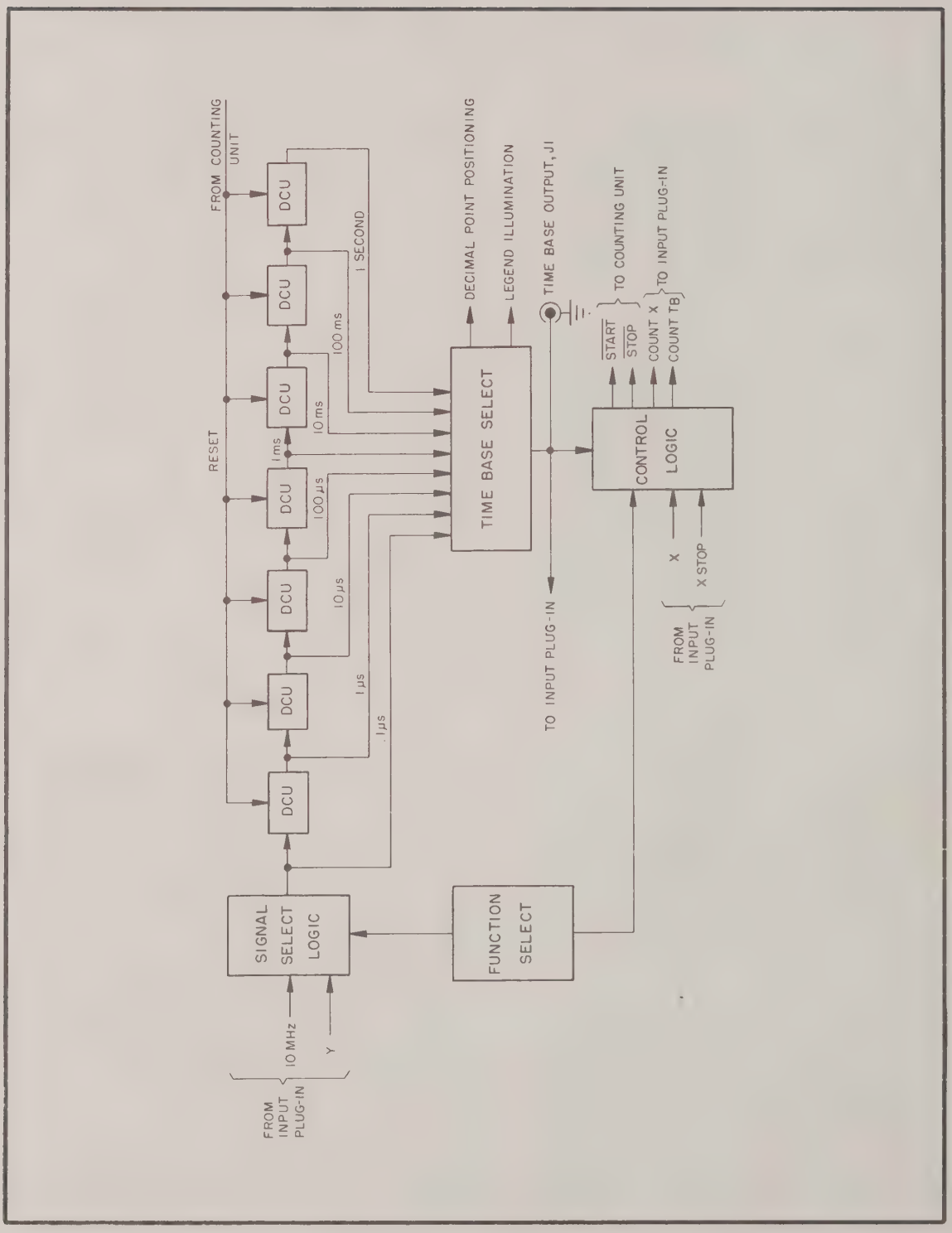


Figure 3-1. Model 673 Function Module Block Diagram

produce accurate timing pulses occurring at intervals ranging from 1 microsecond to 1 second in decade steps, when triggered by the 10 MHz signal. The timing pulses generate the time base.

The seven DCU's are connected in tandem. Each DCU counts ten pulses at its input before recycling. Thus, output pulses from the first DCU occur at 1 microsecond intervals; from the secone, in 10 microsecond intervals; from the third, in 100 microsecond intervals; from the fourth, in 1 millisecond intervals; from the fifth in 10 millisecond intervals; from the sixth, in 100 millisecond intervals; and from the seventh, in 1 second intervals.

The DCU's are reset to nine by the master Reset pulse from the Counting Unit. The outputs of the DCU's are selected through NAND gates by means of the TIME BASE selector. The selected output is routed to the Input Module and to the control logic circuits; it is also available at a BNC connector on the front panel.

3.2.3 Control Logic

The control logic circuits send Start and Stop commands to the Counting Unit, and Count X and Count TB signals to the Input Module. The Start and Stop commands are derived from the Y channel signal for the frequency ratio measurements. They are derived from the 10 MHz signal when totalizing counts and measuring frequency. For the period measurements, they are derived from X and X Stop signals that come directly to the control logic circuits from the Input Module.

The Count X command is generated for measurements of frequency ratio and frequency, and for random-event counting. The Count TB command is generated only for period measurements.

3.2.4 Functional Description

Operation of the Function Module is determined by the particular measurement to be made. In performing any measurement, the instrument operates in accordance with a cyclic pattern that is established by timing circuits in the Counting Unit, but which is initiated by the Start command from the Function Module.

3.2.4.1 COUNT X and FREQ. X Measurements

In the first phase of the cyclic pattern, pulses pass through an accurately-controlled gate, and they are counted by the accumulator in the Counting Unit. For COUNT X and FREQ. X measurements, the gate is opened by the DCU output selected by the TIME BASE selector. The gate then allows signals from the X channel of the Input Module to pass to the accumulator, and the accumulator counts them. Signals pass through the gate until it is closed by the subsequent DCU output selected by the TIME BASE selector. Thus, the duration of the gate is as selected by the TIME BASE selector. This is illustrated by an example.

Assume that the TIME BASE selector is set to the 1 ms position, and the DCU's have just been reset to the count of 9. After the next 10 MHz pulse, the fourth DCU produces an output. The output is selected by the TIME BASE selector, and it generates the Start command. This opens the gate.

After 1 millisecond the fourth DCU recycles to zero. The output, selected by the TIME BASE selector, now generates the Stop command. This closes the gate. Thus, the gate remained open for 1 millisecond.

NOTE

The Start and Stop commands are actually produced simultaneously for all measurements, except PERIOD and COUNT, but the logic of the Counting Unit opens and closes the gate with the proper command.

3.2.4.2 Frequency Ratio Measurements

For frequency ratio measurements, the gate is controlled by the Start and Stop commands in paragraph 3.2.4.1. The DCU's, however, are triggered by the Y channel signal. While the gate is open, the output of the X channel is counted by the accumulator. The count obtained is equal to $\frac{\text{Channel X}}{\text{Channel Y}} \cdot N$, where N is the value selected by the TIME BASE selector. A typical measurement is illustrated by an example.

Assume that the frequency of the signal on the X channel is 5MHz and the frequency of the Y channel signal is 1 MHz. Further assume that the TIME BASE selector is set to the 10^2 position, and the DCU's have just been reset to the count of 9. The DCU's begin counting the 1 MHz output of the Y channel. After the next Y pulse, the second DCU produces an output. The output is selected by the TIME BASE selector, and it generates the Start command. This opens the gate.

After 100 microseconds the second DCU recycles to zero and it produces an output again. The output, selected by the TIME BASE selector, now generates the Stop command. This closes the gate. Thus, the gate remained open for 100 microseconds. During this time, 500 pulses from the X channel passed through the gate and were counted by the accumulator in the Counting Unit. This count appears on the display as the proper answer to our hypothetical measurement.

3.2.4.3 Period Measurement

For period measurements, the X signal from the Input Module produces the Start command; the X Stop signal, also from the Input Module, produces the Stop command. The control logic sends the Count TB command to the Input Module. The DCU output (TB Out) selected by the TIME BASE selector passes through the gate and is counted by the accumulator. A typical measurement is illustrated by an example.

Assume that the signal applied to the X channel of the Input Module is a 45 millisecond pulse. Controls of the Input Module are set such that the leading edge of the pulse starts the count, and the trailing edge stops the count. For the first count, the TIME BASE selector is set to the 1 ms position.

Setting the FUNCTION selector to the PERIOD X position causes the control logic circuits to send the Count TB command to the Input Module, and sets up the logic so that only the X and X Stop commands can generate the Start and Stop commands. Thus, upon receiving the leading edge of the input signal, the Input Module generates the X command, which generates the Start command. This opens the gate, and the 1 millisecond pulses selected by the TIME BASE selector (TB Out) pass through the gate to the accumulator.

After 45 milliseconds, the trailing edge of the input signal generates the X Stop command, which in turn issues the Stop command. This closes the gate, and the accumulator stops counting. The count accumulated while the gate was open will subsequently be on display, and it could be off by one count. If greater resolution is required, to obtain a more accurate measurement, the TIME BASE selector should be set to a smaller time unit.

3.3 BLOCK DIAGRAM DESCRIPTION– MODEL 675

The Model 675 Function Module extends the measuring capabilities over the Model 673 to include multiple periods, time interval (TIME X→Y), and scaling ($\frac{X}{M}$ SCALE). Figure 3-2 is a block

diagram of Model 675; note that it is essentially the same as the block diagram of Model 673 (Figure 3-1). The differences are as follows:

- An additional signal, $\frac{X}{10}$, is applied to the signal select logic.
- A DCU is added to the previous DCU chain.
- Signal X from the Input Module is counted and selected in multiples of 10 before it is applied to the control logic circuits.

The $\frac{X}{10}$ signal is the output of a DCU in the Input Module. This signal triggers the DCU's when the $\frac{X}{M}$ SCALE function is selected. For all other measurements, the signal is inhibited. The additional DCU supplies a 10 second pulse to the TIME BASE selector. The DCU's in the X signal path supply pulses at different repetition rates. Any one of these pulses can be selected to start the count when making multiple period measurements. The PERIOD X selector is part of the FUNCTION selector; it consists of positions 10^1 through 10^5. Because of the similarity of Models 673 and 675 Function Modules, only the additional measurement capabilities are described.

3.3.1 Multiple Periods

For multiple period measurements, the accumulator in the Counting Unit is allowed to count for the number of periods selected. The total count is averaged to yield a more accurate period measurement. A typical measurement is illustrated by an example.

Assume that the period of the signal at the X channel of the Input Module is approximately 20 milliseconds. The TIME BASE selector is set to the 1 ms position, the FUNCTION selector is set to the PERIOD X10^3 position, and the DCU's have just been reset to the count of 9.

With the FUNCTION selector in any of the PERIOD X positions, the Count TB command is sent to the Input Module. The logic circuits are set up so that only the output of the PERIOD X selector can initiate the Start and Stop commands. Incoming signals to the X channel become the X pulses that trigger the DCU's associated with the PERIOD X selector. These DCU's begin counting the X pulses. After the first pulse, the third DCU produces an output. The output is selected by the PERIOD X selector, and it generates the Start command. This opens the gate.

After 20 seconds the third DCU recycles to zero, and produces an output again. The output, selected by the PERIOD X selector, now generates the Stop command. This closes the gate. Thus, the gate remained open for 20 seconds. During this time, the 1 ms pulses from the time base select circuit passed through the gate and were counted by the accumulator of the Counting Unit.

The total count is subsequently displayed, and the decimal point is positioned three places to the left of the units digit. Moving the decimal point to the left divides the total count by 1000, the number of periods during which the measurement was made. The net result is that the 1 ms pulses were counted and accumulated for 1000 periods, and then averaged to yield a more accurate period measurement.

3.3.2 Time Interval Measurements

For time interval measurements, the instrument measures the elapsed time between the occurrence of an event at the X channel and a subsequent event at the Y channel. The measurement is performed in a manner similar to the period measurement. The X signal from the Input Module produces the Start command. The Stop command, however, is produced by the Y signal, rather than by the X Stop signal. A typical measurement is illustrated by an example.

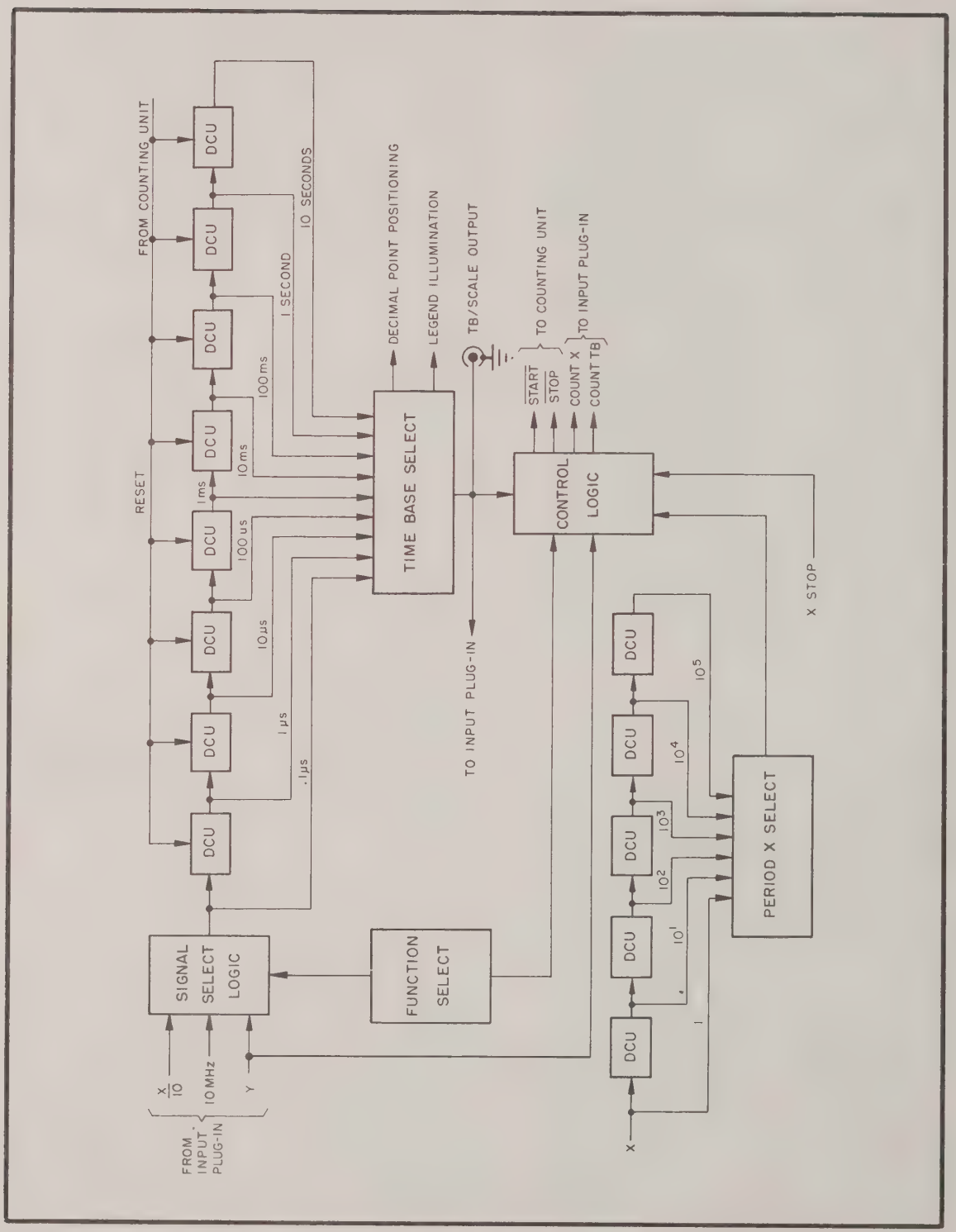


Figure 3-2. Model 675 Function Module Block Diagram

Assume that the signal at the Y channel occurs approximately 50 milliseconds later than the signal at the X channel. The TIME BASE selector is set to the 100 μs position; it is felt that this provides adequate resolution for this measurement.

Setting the FUNCTION selector to the TIME X↔Y position causes the control logic circuits to send the Count TB command to the Input Module, and sets up the logic so that only the X and Y signals can generate the Start and Stop commands. Thus, upon receiving the X signal, the unit generates the Start command. This opens the gate, and the 100 μs pulses selected by the TIME BASE selector (TB Out) pass through the gate to the accumulator.

After approximately 50 milliseconds, the Y channel of the Input Module generates the Y signal, which now issues the Stop command. This closes the gate, and the accumulator stops counting.

3.3.3 Frequency Scaling

Frequency scaling is the division of the X channel signal by a factor M. The factor M is selected by the TIME BASE selector in decade steps from 10^1 to 10^9. The scaled frequency is not displayed; it is made available at the TB/SCALE OUTPUT connector.

Selecting the $\frac{X}{M}$ SCALE mode of operation causes the Count X and Start commands to be generated. Simultaneously, the 10 MHz and Y signals to the signal select logic circuits are inhibited, but the $\frac{X}{10}$ signal is enabled. The Start command produces the gate from the Counting Unit. The gate and the Count X command enable the input signal at the Input Module. The Input Module divides the input signal by 10, producing the $\frac{X}{10}$ signal.

The $\frac{X}{10}$ signal passes through the signal select logic circuits and is counted down in decade steps, producing M factors 10^1 through 10^9. These signals are available for selection by the TIME BASE selector. The selected signal appears at the TB/SCALE OUTPUT connector.

3.4 INTEGRATED CIRCUIT LOGIC

Monolithic integrated circuits are used extensively in the Beckman Counters. In some cases an IC package contains two or more basic logic elements, such as resistor-transistor logic gates (RTL), diode-transistor logic gates (DTL), transistor-transistor logic gates (TTL), buffer amplifiers, and flip-flops. These basic logic elements are interconnected to perform the required logic function.

In other IC packages, such as the DCU and BCD-to-decimal decoder, the logic elements are interconnected internally, and little or no wiring external to the package is required. These packages simply receive the input signal(s) and produce the required outputs.

In the following paragraphs, typical circuits are shown symbolically and/or schematically. Truth tables or waveforms are included to define logic outputs for the different logic inputs. In this equipment, a high level is "true"; a low level is "false".

3.4.1 Resistor-Transistor Logic Gate (RTL)

Figure 3-3 illustrates a typical RTL gate. This circuit, for positive logic signals, is a NOR gate. NOR gates can be considered as OR gates whose outputs are inverted. If either of the inputs is high, then the output is low. Only when both inputs are low simultaneously is the output high.

3.4.2 Diode-Transistor Logic Gate (DTL)

Figure 3-4 illustrates a typical DTL gate. As shown in the truth table, the output is high for all logic input conditions, except in the case when both inputs are high simultaneously. The circuit consists of an AND gate, an emitter follower, and a commom emitter amplifier. The AND gate produces a high output only when its two inputs are also high. The emitter follower couples the output of the AND gate to the common emitter amplifier. Thus, the transistor is ON only when the output of the AND gate is high.

3.4.3 Five-Input DTL Gate

Figure 3-5 illustrates a DTL gate with five inputs. Circuit operation is identical to the DTL gate shown in Figure 3-4. Two of these NAND gates (not AND) are contained in a single package. Two or more inputs are used for the NAND function; other inputs are left open. When all inputs are used, an external diode may be connected to pin X. The logic equation for this circuit shows that if any input is false, the output is true.

3.4.4 Transistor-Transistor Logic Gate (TTL)

Figure 3-6 illustrates a two-input TTL gate. Note that logically this gate is the same as the DTL gate. TTL gates are used mainly because they are capable of supplying more current than a comparable DTL gate. They have good capacitive load driving capabilities. In this equipment, the TTL IC packages contain four NAND gates.

3.4.5 Buffer Amplifiers

Figure 3-7 illustrates an IC package that contains six buffer amplifiers. As shown in the truth table, these buffers invert the input. Buffer amplifiers provide power amplification and isolate the signal source from the external loading.

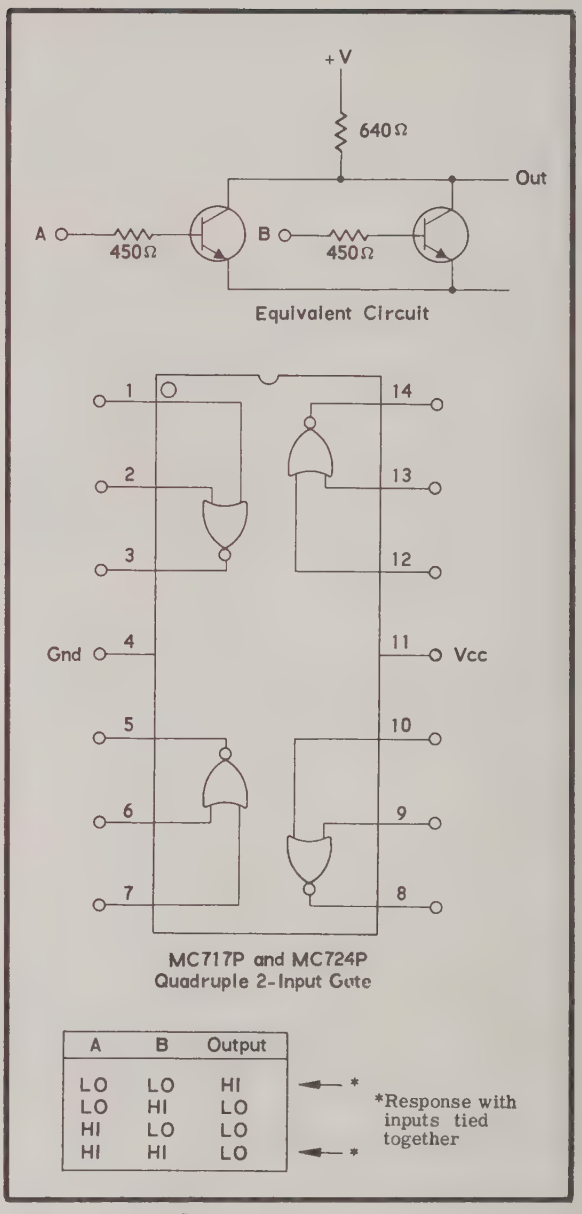
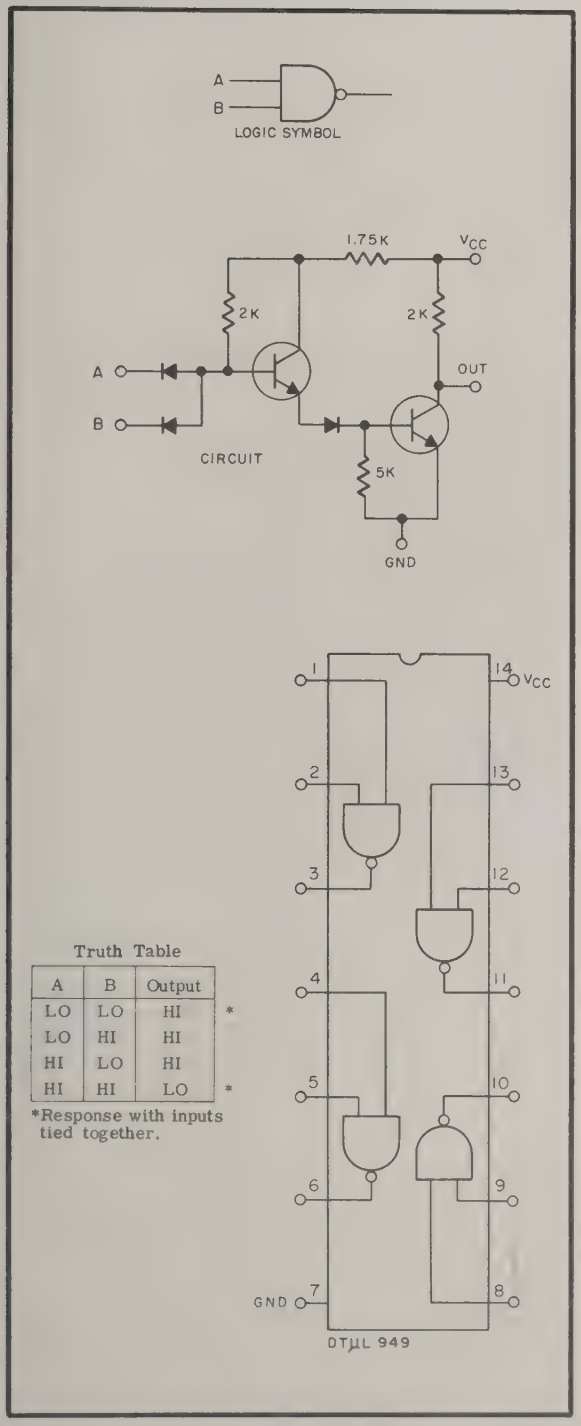


Figure 3-3. RTL Gate Logic

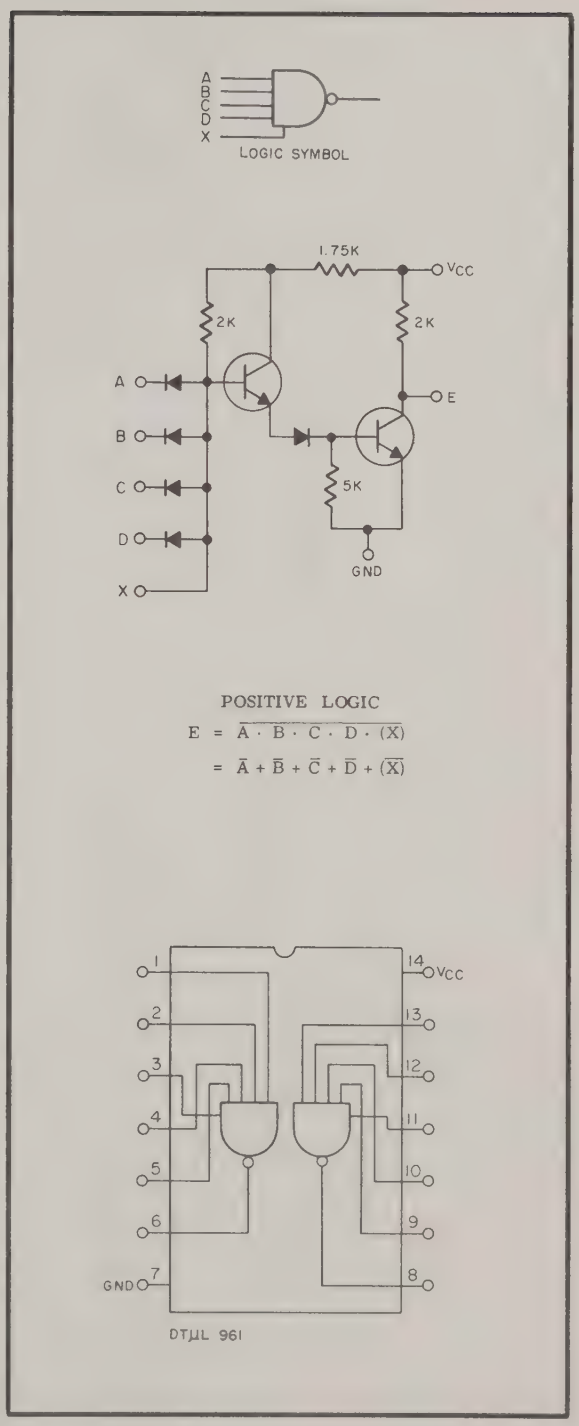


Truth Table

A	B	Output	
LO	LO	HI	*
LO	HI	HI	
HI	LO	HI	
HI	HI	LO	*

*Response with inputs tied together.

Figure 3-4. DTL Gate Logic

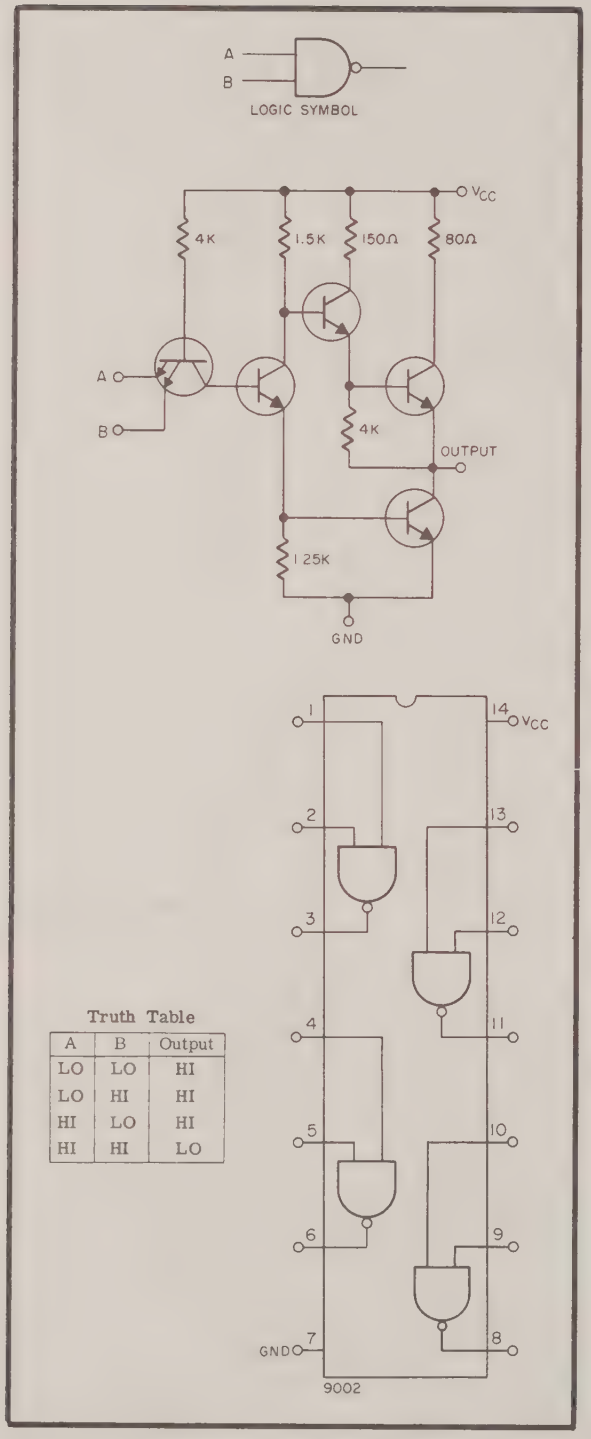


POSITIVE LOGIC

$$E = \overline{A \cdot B \cdot C \cdot D \cdot (X)}$$

$$= \overline{A} + \overline{B} + \overline{C} + \overline{D} + (\overline{X})$$

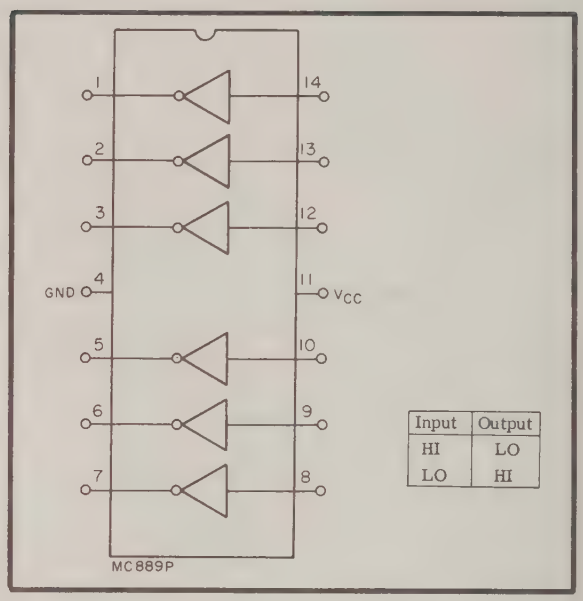
Figure 3-5. Five-Input DTL Gates



Truth Table

A	B	Output
LO	LO	HI
LO	HI	HI
HI	LO	HI
HI	HI	LO

Figure 3-6. Two-Input TTL Gates



Input	Output
HI	LO
LO	HI

Figure 3-7. Buffer Amplifiers

3.4.6 Decimal Counting Unit

Figure 3-8 illustrates the decimal counting unit. This device consists of four flip-flops interconnected to recycle after it counts ten input pulses. The outputs are in 1-2-4-8 BCD form; waveforms are shown for each flip-flop. The A flip-flop is a binary counter. The B, C, and D flip-flops make up a divide-by-5 counter. Thus, when an external lead is connected between pins 1 and 12, the device is a divide-by-10 counter.

3.4.7 BCD-to-Decimal Decoder/Driver

Figure 3-9 illustrates a BCD-to-decimal decoder/driver. This IC package converts the BCD outputs of the DCU (Figure 3-8) to decimal form. As shown in the associated truth table, only one particular output is ON for each of the ten different input configurations. The output that is ON completes the circuit for a corresponding cathode of the glow tube that displays the decimal number.

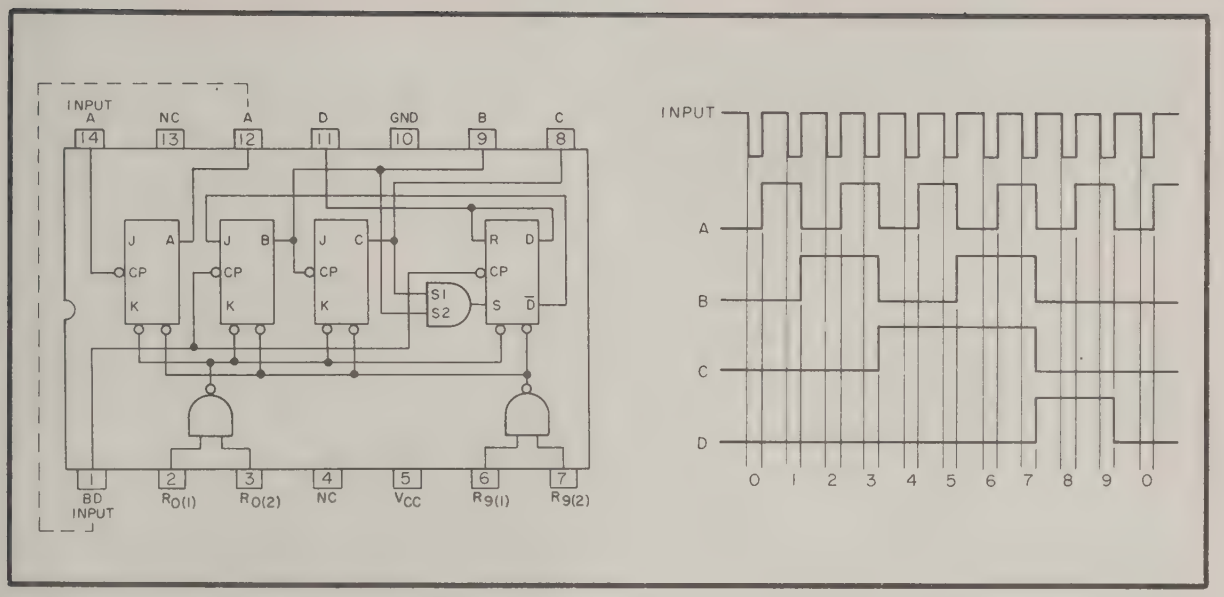


Figure 3-8. Decimal Counting Unit (DCU)

Truth Table

Input				Output ON*
D	C	B	A	
LO	LO	LO	LO	0
LO	LO	LO	HI	1
LO	LO	HI	LO	2
LO	LO	HI	HI	3
LO	HI	LO	LO	4
LO	HI	LO	HI	5
LO	HI	HI	LO	6
LO	HI	HI	HI	7
HI	LO	LO	LO	8
HI	LO	LO	HI	9

*All other outputs are OFF.

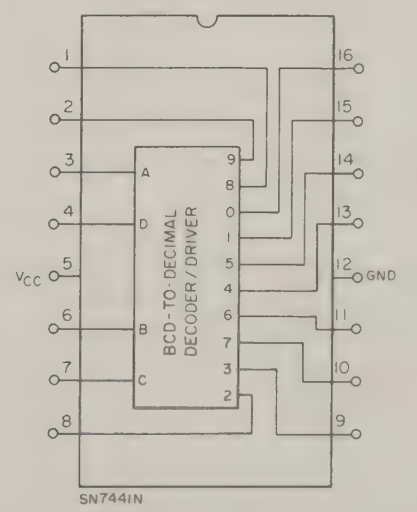


Figure 3-9. BCD-to-Decimal Decoder/Driver

3.5 DETAILED LOGIC DESCRIPTION

The basic logic of Model 673 is contained in Model 675 and is not discussed in detail separately. Differences between the two modules are listed in paragraph 3.3. Refer to the logic diagrams in Section 5 while reading the following descriptions.

3.5.1 Time Base Selection

Model 675 uses one of three input time bases: 10 MHz, $\frac{X}{10}$ channel (not available in Model 673), or Y channel. The Y channel is not contained in the Model 682 Input Module, so functions using this time base, $\frac{X}{Y}$·N RATIO and TIME X→Y, are not possible with the single channel module.

Function switches S2B and S2C control NAND gates Z1A, Z1C, and Z12D in selecting the proper time base. NAND gate Z1A (Z1D in Model 673) inhibits the Y channel signal except for the $\frac{X}{Y}$ N RATIO (RATIO in Model 673) function which uses a Y signal time standard. NAND gate Z1C inhibits the $\frac{X}{10}$ channel signal except for the $\frac{X}{M}$ SCALE function which uses an $\frac{X}{10}$ signal time standard. NAND gate Z12D (Z1A in Model 673) allows the 10 MHz signal to pass for all functions, except $\frac{X}{Y}$ N RATIO and $\frac{X}{M}$ SCALE, and is used as the time standard.

The time base signal enters NAND gate Z1B and passes into the eight DCU's of Model 675 or seven DCU's of Model 673. The units of the time base are selected by the TIME BASE switch (S1L); 0.1 microsecond to 10 seconds may be selected in Model 675, 0.1 microsecond to 1 second in Model 673. The outputs of the DCU's are switched through NAND gate Z19B (Z11 in Model 673), inverted by NAND gate Z20C (Z1C in Model 673), fed to NAND gate Z22B (Z13B in Model 673), and terminated at the TB/SCALE OUTPUT connector J1 on the front panel (TIME BASE OUTPUT in Model 673), and pin 26 of the rear-panel connector P6. NAND gate Z22B, controlled by FUNCTION switch S2A, passes an inverted signal for the $\frac{X}{Y}$·N RATIO and FREQ. X functions and a high (Hi) output for other functions.

For DCU logic refer to the Models 6360, 6370, and 6380 Operating and Servicing Manual, paragraph 3.3.7.

3.5.2 HOLD Function

The HOLD position of S2A grounds the $\overline{\text{Stop}}$ Recycle line, inhibiting stop pulses at NAND gate Z2D of the basic 6300 Series Counter, and locks the Display Time circuitry to continuous display.

CR6 assures continuance of the $\overline{\text{Stop}}$ Recycle command for COUNT X and SCALE functions, and prevents a Hi level from reaching NAND gate Z2D in the basic counter while switching the FUNCTION switch to the HOLD position.

3.5.3 COUNT X Function

Switching S2A to the COUNT X position locks NAND gate Z22B at a Hi output level (NAND gates Z22D and Z24B are also locked with Hi outputs), and grounds pin 9 of NAND gate Z25B, initiating the $\overline{\text{Start}}$ pulse which is inverted by NAND gate Z21C. The input to the $\overline{\text{Stop}}$ Recycle control is low (Lo), locking Z2D in the basic counter.

Pressing the RESET button of the 6300 Series instrument clears the counter and the DCU's in all units. These units must be cleared before using another function.

3.5.4 $\frac{X}{Y}\cdot N$ RATIO Function

The Y input channel time standard is used for this function. S1L selects the N multiple decade unit for $\frac{X}{Y}\cdot N$ RATIO. Output pulses from the DCU's (NAND gate Z19B) go through a double inversion at NAND gates Z20C and Z22B, and controls the output pulses of NAND gates Z25A and Z25B; the other inputs to these gates are at Hi levels. Depending upon the state of flip-flop Z1A-Z1D in the basic counter, the counter is stated and stopped by successive pulses. S2A switches NAND gate Z21B to a Hi output level and initiates COUNT X to NAND gate Z4A in the Input Module.

3.5.5 FREQ. X Function

The time standard of 10 MHz is used; S1L selects the time scale. NAND gates Z25A and Z25B are switched as in RATIO function. S2A switches NAND gate Z21B to a Hi output to initiate COUNT X in the Input Module.

3.5.6 $\frac{X}{M}$ SCALE Function

The time standard of $\frac{X}{10}$ is used; S1L selects the value of M used in $\frac{X}{M}$ SCALE. Output pulses from the DCU's (Z19B) are inverted by NAND gate Z20C and appear at J1 and the TB/SCALE OUTPUT terminal.

3.5.7 TIME X→Y Function

Time standard of 10MHz is used; S1L selects the internal resolutions. The X start signal is selected by the START SLOPE signal switch S1 and logic (Input Module), and fed to NAND gate Z22D. A Lo input to NAND gate Z23C and S2A locks it at a Hi output level. This allows NAND gate Z22D pulses to control NAND gate Z25B, initiating the $\overline{\text{Start}}$ pulse. The Lo input from S2A also switches NAND gate Z21A to a Hi output which initiates the Count TB signal. STOP SLOPE switch S2B and logic of the Y channel (of Input Module) sends a signal pulse to NAND gate Z22A which triggers NAND gate Z25A to give a positive output pulse to initiate the stop count ($\overline{\text{Stop}}$).

3.5.8 PERIOD X and Multiple Period Averaging

The time standard of 10 MHz is used; S1L selects the time interval resolution. The inverted output pulses from the DCU's appear at J1 and pin 26 of P6 (TB Out).

Start Pulse:

NAND gates Z22B, Z21A, and Z23D are locked in the Hi output mode by S2A. Pin 9 of NAND gate Z25B is locked at a Hi level by R15 and S2A. NAND gate Z25B is controlled by the output of Z24B which is controlled by the output of NAND gate Z19A inverted by NAND gate Z20B.

X Input:

START SLOPE switch S1 and the logic of the Input Module select the slope of the X input pulse for the PERIOD X function. NAND gate Z22C inverts X input (pin 21 of P6) signal pulses before they are fed into the bank of five DCU's for period averaging. For single period, NAND gates Z22B, Z24A, and Z24C are at Hi output levels, and NAND gate Z25A is controlled by NAND gate Z24C output pulses which receives the X Stop command pulses from the STOP SLOPE switch S2A and the logic of the Input Module. For multiple period averaging, NAND gate Z24C is locked at a Hi output level. Pulses from the period averaging DCU's are fed from NAND gate Z19A, inverted by NAND gate Z20B, and in turn go to NAND gate Z24A. The output of Z24A switches NAND gate Z25A, controlling the stop counter impulse ($\overline{\text{Stop}}$). Pressing the RESET button clears all DCU's in the Function Module.

3.5.9 Timing Diagram - Signals vs. Function

Figure 3-10 shows the states of timing and control lines during the various modes of operation. This timing diagram is particularly helpful in understanding the relationships among the pulses and signals generated in the 6300 Series Counting Unit and Function and Input Modules.

NOTE

Figure 3-10 applies to the following modules and their combinations when used with a Model 6360, 6370, or 6380 Counting Unit:

Function Module: Model 673, Model 675
Input Module: Model 682, Model 683

For other configurations, refer to the individual manuals for the module involved.

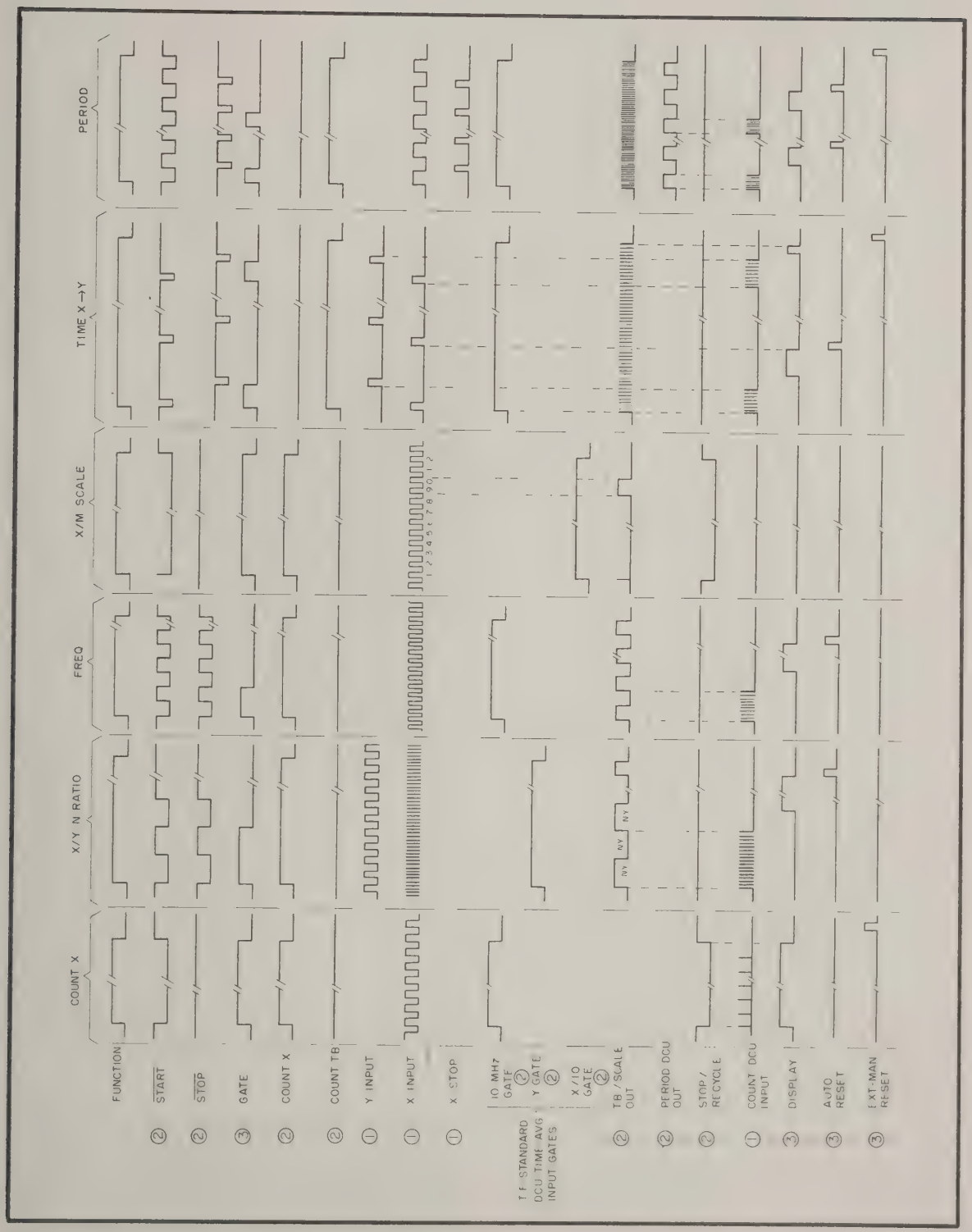


Figure 3-10. Timing Diagram

SECTION 4
MAINTENANCE

4.1 GENERAL

Because the Function Modules are designed for use with Models 6360, 6370, and 6380 Counting Units, maintenance procedures included in the manual for the latter instruments will not be discussed here. Such topics as Preventive Maintenance, Servicing Integrated Circuits, and general procedures for Troubleshooting apply to both the Counting Units and Modules, and are covered quite thoroughly in the manual for Models 6360, 6370, and 6380.

Procedures and data which apply only to Models 673 and 675 are given in the following paragraphs.

4.2 PREPARING THE INSTRUMENT FOR TROUBLESHOOTING

Operating power is furnished by the Counting Unit via multi-pin connectors at the rear of the modules. For this reason, the modules must be installed in the Counting Unit when checking operation. To prepare the instrument for troubleshooting, follow these procedures:

1) Remove the top and bottom covers of the Counting Unit. The covers lift off after removing the eight screws holding each.

2) Remove the top cover of Model 673 or 675 and replace the module in the top slot of the Counting Unit.

3) Remove bottom cover of the Input Module (Model 682, 683, or 685) and replace the module in the bottom slot of the Counting Unit.

4) Turn the Counting Unit on one of its sides with the front panel toward the operator. The power supply, oscillator, Counting Unit board, and Function Module board are now exposed on one side (top), while the Input Module board is accessible from the other.

4.3 ADJUSTMENTS

The Function Modules do not require any adjustments.

4.4 TROUBLESHOOTING AIDS

4.4.1 Drawings

Schematic diagrams and assembly drawings are given in Section 5, in addition to a complete logic diagram for the modules.

4.4.2 Simplified Logic-Block Diagrams

Simplified logic-block diagrams for both Models 673 and 675 are shown in Figures 4-1 and 4-2, respectively. The various functional sections can be classified as follows:

- Signal Select Logic.
- Time Base Dividers (DCUs) and Switch.
- Function Switch.
- Period Dividers (DCUs).
- Control Logic
- Inputs.
- Outputs.

4.4.3 Component Location

The top view of Model 675 with cover removed and showing callouts is given in Figure 4-3.

4.4.4 Waveforms

Waveform photographs for important test locations are given in Table 4-1 of the Models 6360, 6370, and 6380 manual. The table indicates the conditions, test point, and scope legend used to obtain each waveform. Note that the instrument configuration used to obtain the photographs is the Model 6380 Counting Unit with Model 675 Function Module and Model 685 Input Module.

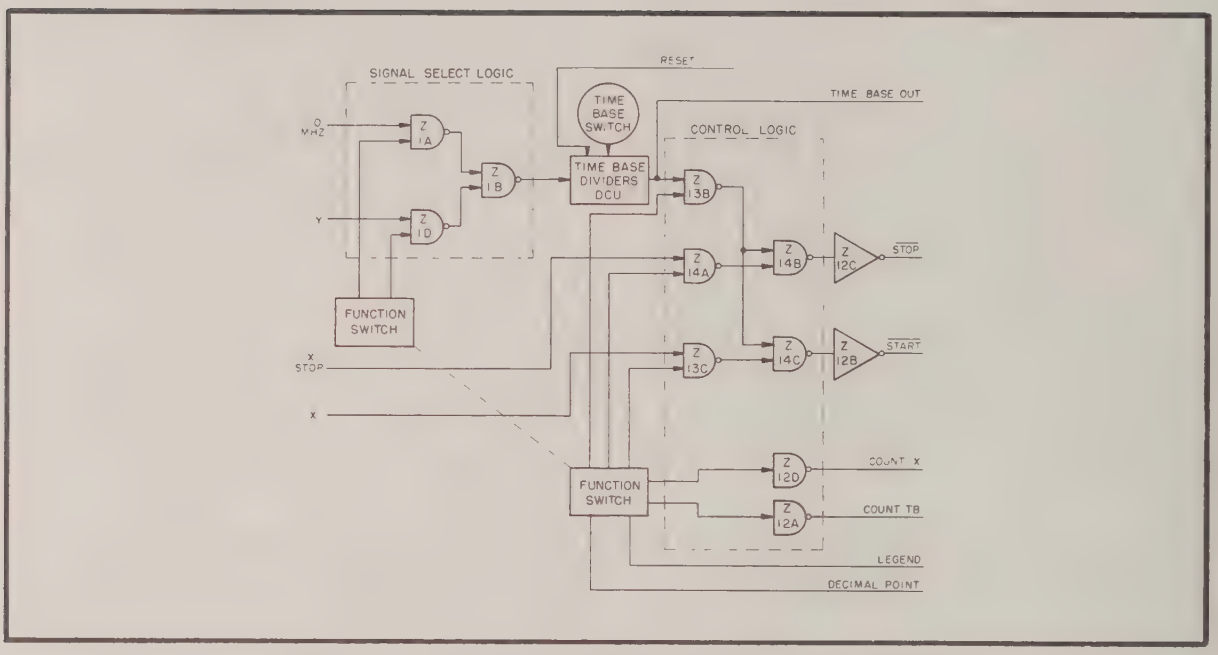


Figure 4-1. Model 673 Simplified Logic-Block Diagram

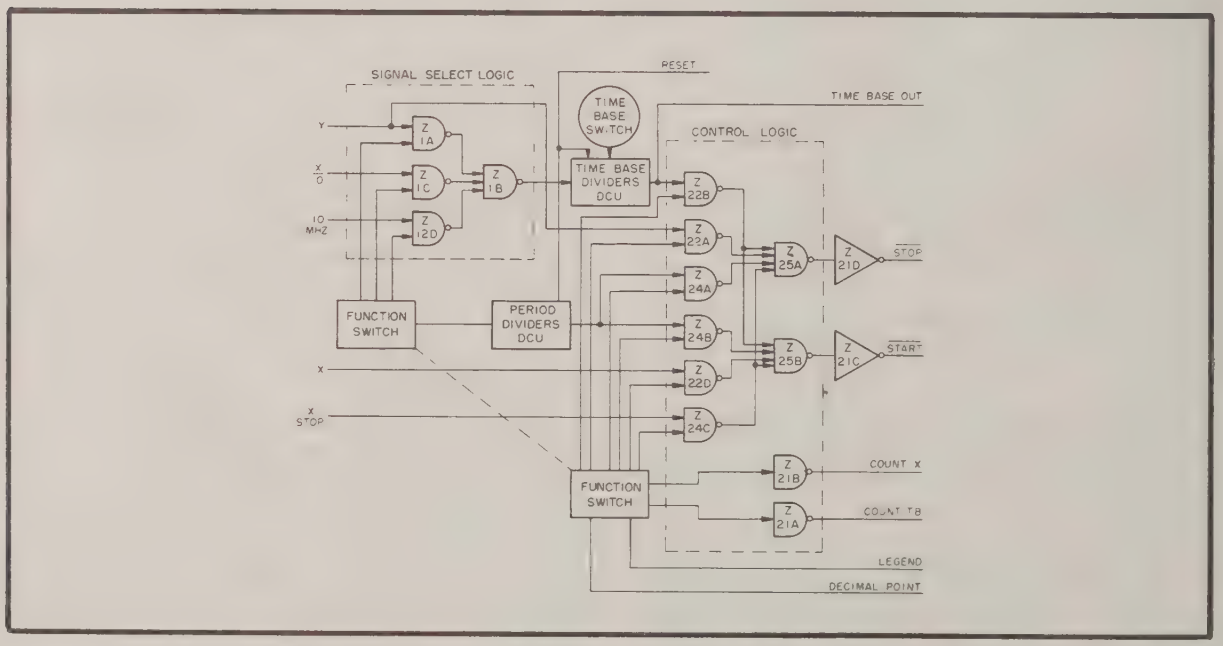


Figure 4-2. Model 675 Simplified Logic-Block Diagram

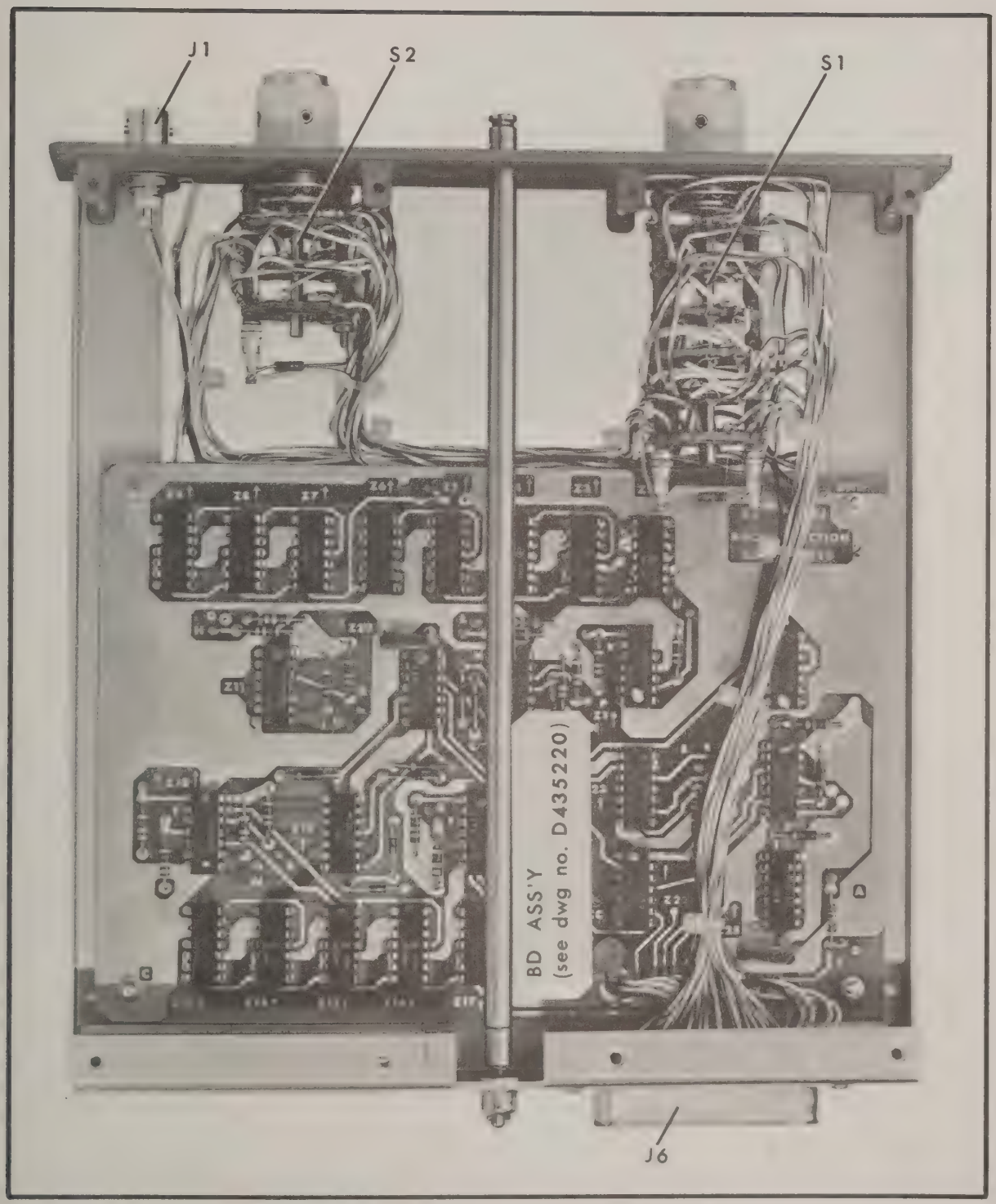


Figure 4-3. Top View of Model 675 without Cover

SECTION 5
DIAGRAMS & PARTS LISTS

Following is a list of diagrams and parts lists for Models 673 and 675 contained in this section:

Diagram or Parts List	Dwg. No.	Page
Model 673 EPUT Board Assembly Diagram	D435190(C)	5-2
Model 673 EPUT Board Assembly Parts List		5-3
Model 675 BUCAT Function Board Assembly Diagram	D435220(B)	5-4
Model 675 BUCAT Function Board Assembly Parts List		5-5
Model 673 Logic Diagram	D435284(C)	5-6
Model 675 Logic Diagram	D435779(B)	5-7
Model 673 EPUT Mechanical and Wired Assembly Diagram	D435282(C)	5-8
Model 673 EPUT Mechanical and Wired Assembly Parts List		5-9
Model 675 BUCAT Mechanical and Wired Assembly Diagram	D435376(D)	5-10
Model 675 BUCAT Mechanical and Wired Assembly Parts List		5-11
Model 673 EPUT Final Assembly Diagram	D435260(C)	5-12
Model 675 BUCAT Final Assembly Diagram	D435270(C)	5-13

QTY	REV	ZONE	DESCRIPTION	ECO No.	DATE	BY	CHK'D	APP'D
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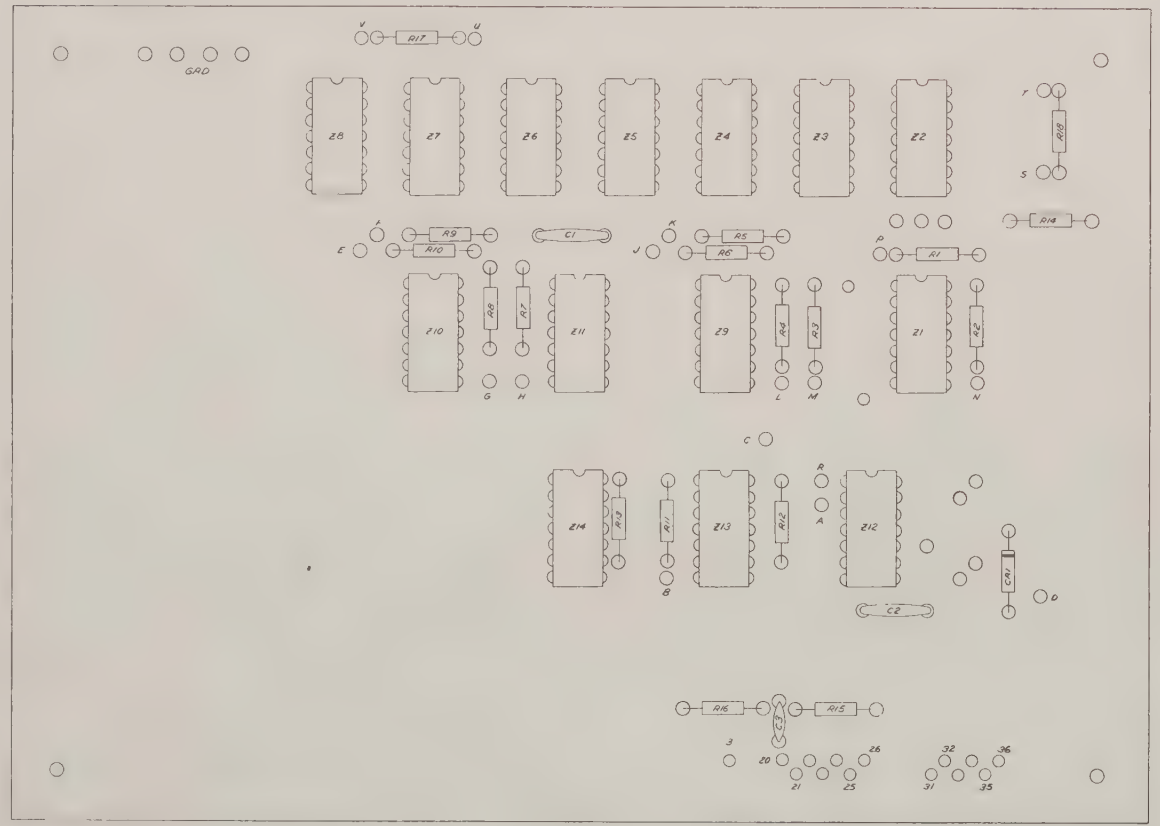
	C		OBSOLETE REV B	12080	2/68	W.S.	L.W.	[illegible]



ITEM	PART NO	DESCRIPTION	QTY
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2	D022-435284	LOGIC DIA, EPUT	REF
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UNLESS OTHERWISE SPECIFIED
TOLERANCES
X ± .020 ANGULAR ± 0° 30'
.XX ± .010
.XXX ± .005 MACH. SURF ✓
THREADS: CLASS 3A OR 2B
SHARP EDGES & SHARP ITEMS .005 MAX
MACH. FILLET RADIUS .010 MAX
MACH. SURF. FLAT WITHIN .005 IN .1 IN
OTHER SURF. FLAT WITHIN .005 IN .1 IN
CONCENTRICITY: MACH. SURF. TO BE WITHIN .1% RUN OF DIA. TOL. .001" MIN.
DO NOT SCALE DRAWING

	BY	DATE
DRAWN	Shimoda	5-67
CHKD	[illegible]	5/67
ENGR	L. Davis	4/67
APPD		
APPD		

TITLE: BOARD ASSEMBLY, 673 EPUT

Beckman® INSTRUMENTS, INC. ELECTRONIC INSTRUMENTS DIVISION

MATERIAL

FINISH

SCALE 3:1

SIZE D | 855-435190 | C

SHEET 1 OF 1

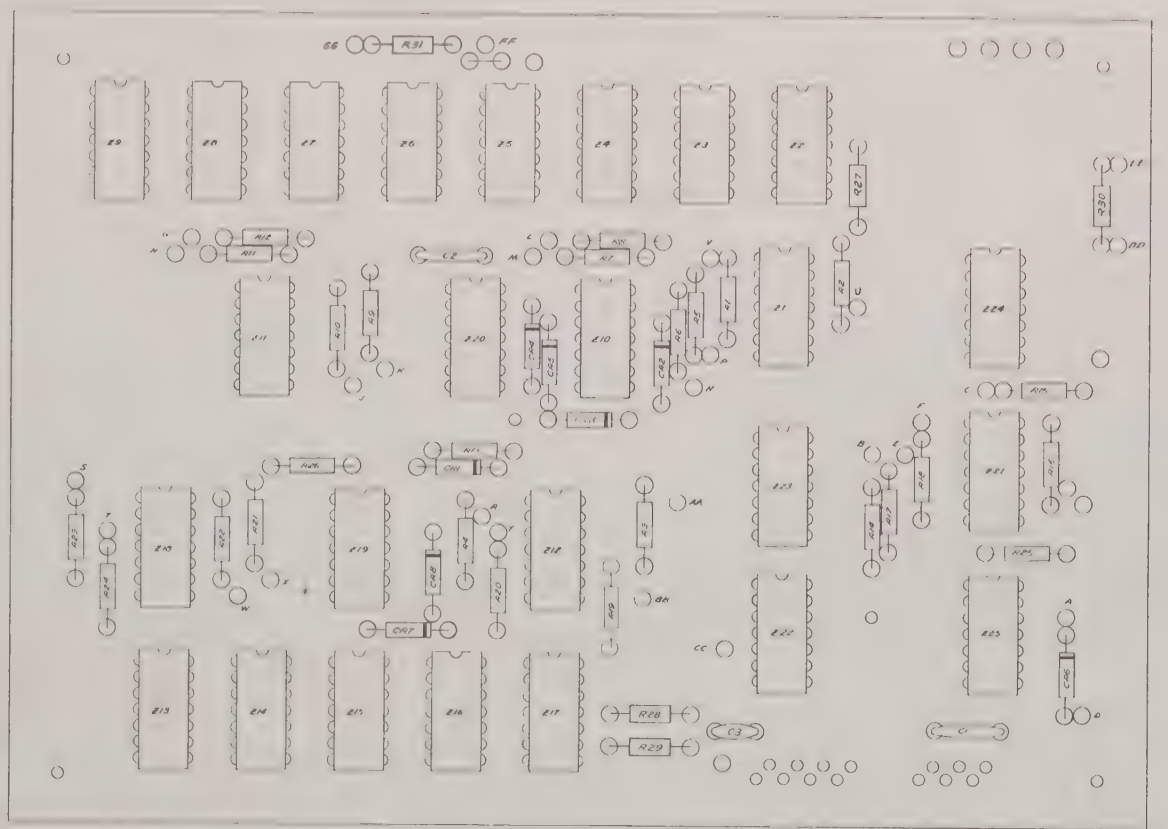
A037-435188 673
NEXT ASSY USED ON
APPLICATION

855-435190 C1

MODEL 673 EPUT BOARD ASSEMBLY PARTS LIST

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
	*855-435190(C)	Model 673 EPUT Board Assembly	Beckman	1
C1, 2	633-815873	Capacitor, F., Cerm., 0.33μf, 25V	Sprague 5C10A	2
C3	633-836864	Capacitor, F., Cerm., 0.01μf, 50V	Sprague 19C214A6	1
CR1	755-402107	Diode, Special	Beckman	1
R1 thru R13	601-823902	Resistor, F., Comp., 47K, 1/4W, 5%	Allen Bradley CB4735	13
R14	601-822308	Resistor, F., Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	1
R15	601-823396	Resistor, F., Comp., 560Ω, 1/4W, 5%	Allen Bradley CB5615	1
R16	601-823393	Resistor, F., Comp., 270Ω, 1/4W, 5%	Allen Bradley CB2715	1
R17, 18	601-822301	Resistor, F., Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	2
Z1, 9, 10, 12, 13	885-435206	I. C., Quad 2-Input Gate	Beckman	5
Z2	885-435184	I. C., Decade Counter, 25 MHz	Beckman	1
Z3, 4, 5, 6, 7, 8	885-435168	I. C., Decade Counter, 10 MHz	Beckman	6
Z11	885-435205	I. C., Gate, Single, 8-Input	Beckman	1
Z14	885-435204	I. C., Gate, Triple, 3-Input	Beckman	1

*P/L: A435188(B)



	B		SEE E C O.	18075	2/5/69	CAT	M		

1	A037-435218	PARTS LIST	BUCAT		1
ITEM	PART NO.	DESCRIPTION			QTY.

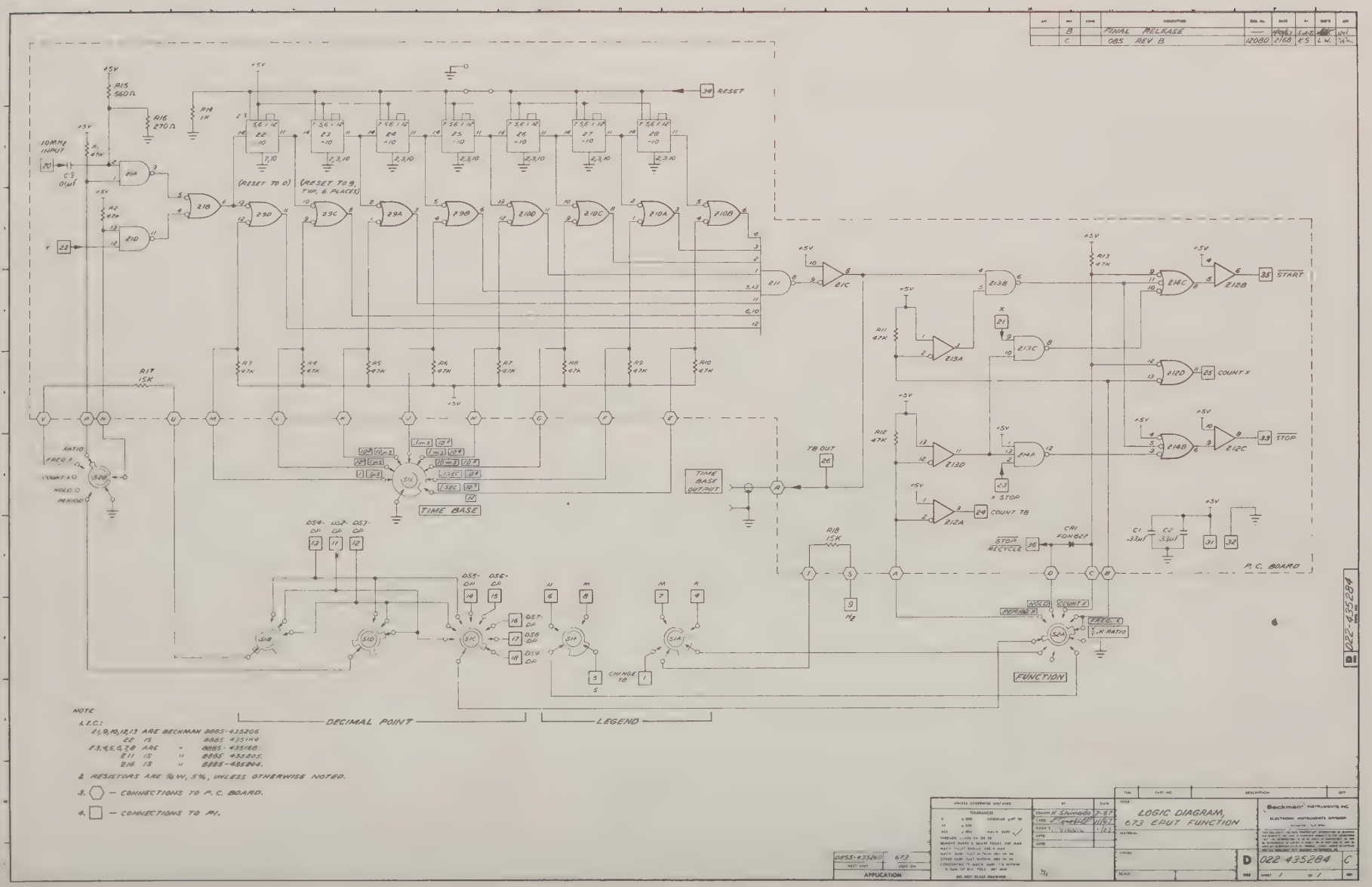
DRAWN	Ahmadd	3-67	BOARD ASSY BUCAT FUNCTION	Beckman INSTRUMENTS, INC. ELECTRONIC INSTRUMENTS DIVISION
CHKD				
APPD				
MFG				
SCALE	2/1		D	855-435220 B
			SIZE	SHEET 1 OF 1 REV

A037-435218 675
PART NO. USED ON
APPLICATION

855-435220
REV. LTR.

MODEL 675 BUCAT FUNCTION BOARD ASSEMBLY PARTS LIST

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
	855-435220(B)	Model 675 BUCAT P.C. Assy.	Beckman	1
C1, 2	633-815873	Capacitor, F., Cerm., 0.33μf, 25V	Sprague 5C10A	2
C3	633-836864	Capacitor, F., Cerm. 0.01μf, 50V	Sprague 19C214A6	1
CR1, 2, 3, 4, 5, 7, 8	755-845049	Diode, Type FDH 627	Fairchild	7
CR6	755-402107	Diode, Special	Beckman	1
R1 thru R12, R14, 15, R17 thru R24	601-823902	Resistor, F., Comp., 47K, 1/4W, 5%	Allen Bradley CB4735	22
R13, 16, 25, 26, 27	601-822308	Resistor, F., Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	5
R28	601-823396	Resistor, F., Comp., 560Ω, 1/4W, 5%	Allen Bradley CB5615	1
R29	601-823393	Resistor, F., Comp., 270Ω, 1/4W, 5%	Allen Bradley CB2715	1
R30, 31	601-822301	Resistor, F., Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	2
Z1, 24	885-435204	I.C., Gate, Triple 3 Input	Beckman	2
Z2, 17	885-435184	I.C., Decade Counter, 25 MHz	Beckman	2
Z3 thru Z9, Z13, 14, 15, 16	885-435168	I.C., Decade Counter, 10 MHz	Beckman	11
Z10, 11, 12, 18, 20, 21, 22, 23	885-435206	I.C., Gate, Quad, 2 Input	Beckman	8
Z19, 25	885-435207	I.C., Gate, Dual, 4 Input	Beckman	2



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	C		085 REV B	12080	2/68	K.S	L.W.	

NOTE

1. I.C.:
   E1,9,10,12,13 ARE BECKMAN 0085-433206
   E2 IS " 0085-435148
   E3,4,5,6,7,8 ARE " 0085-435168
   E11 IS " 0085-433205
   E16 IS " 0085-435204.
2. RESISTORS ARE ¼W, 5%, UNLESS OTHERWISE NOTED.
3. ⬡ — CONNECTIONS TO P.C. BOARD.
4. □ — CONNECTIONS TO PI.

UNLESS OTHERWISE SPECIFIED	BY	DATE
TOLERANCES	DRAWN K Shimada	7-67
	TRACED	11/67
	CHK'D K. Shimada	1/68
	APP'D	
	MFG	

ITEM	PART NO.	DESCRIPTION	QTY

TITLE: LOGIC DIAGRAM, 673 EPUT FUNCTION

Beckman® INSTRUMENTS, INC. ELECTRONIC INSTRUMENTS DIVISION

MATERIAL

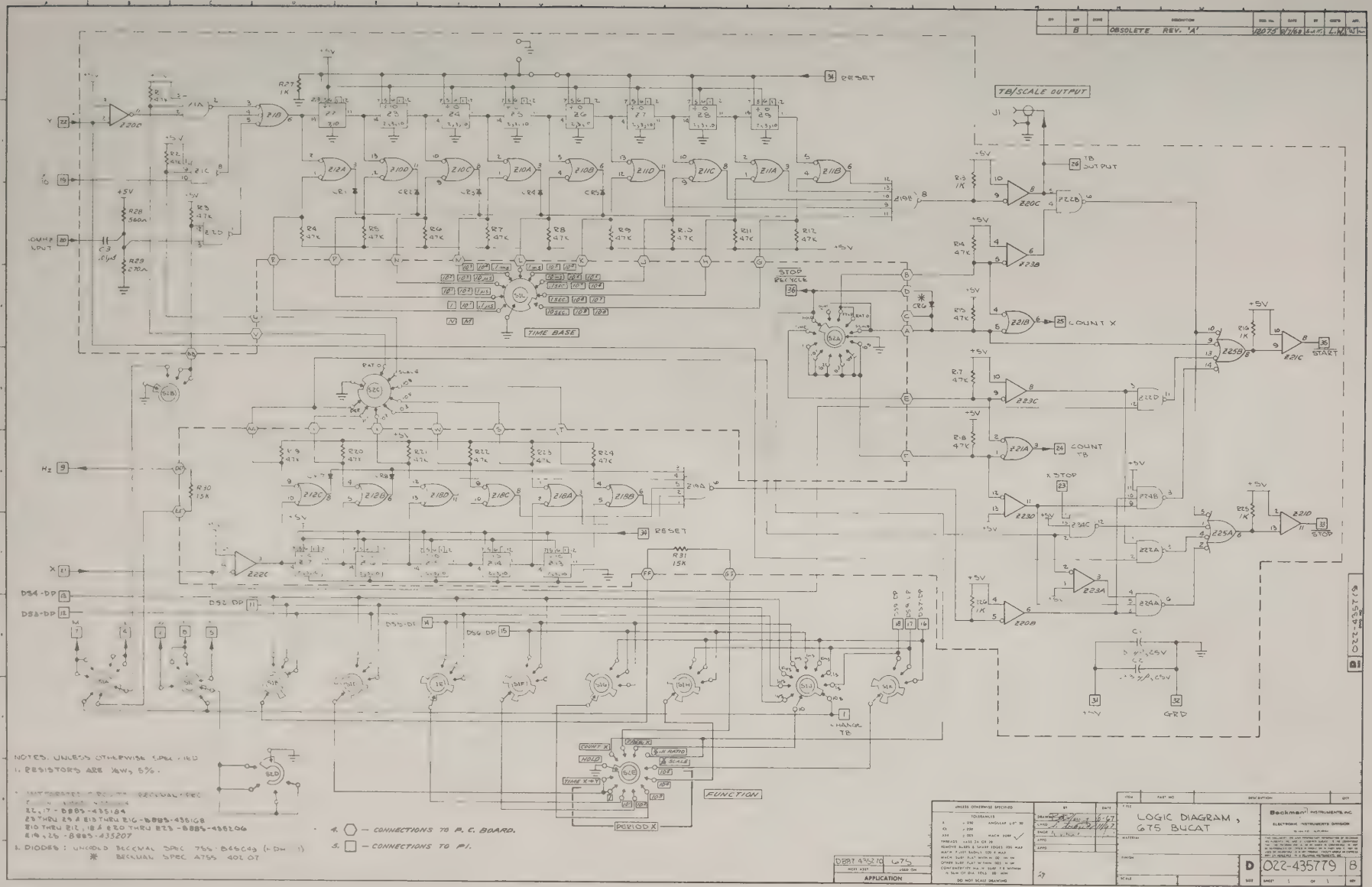
FINISH

SIZE: D | 022 435284 | C

SHEET 1 OF 1

0055-435260 | 673 | NEXT ASSY | USED ON | APPLICATION

D 022-435284



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE ¼W, 5%.
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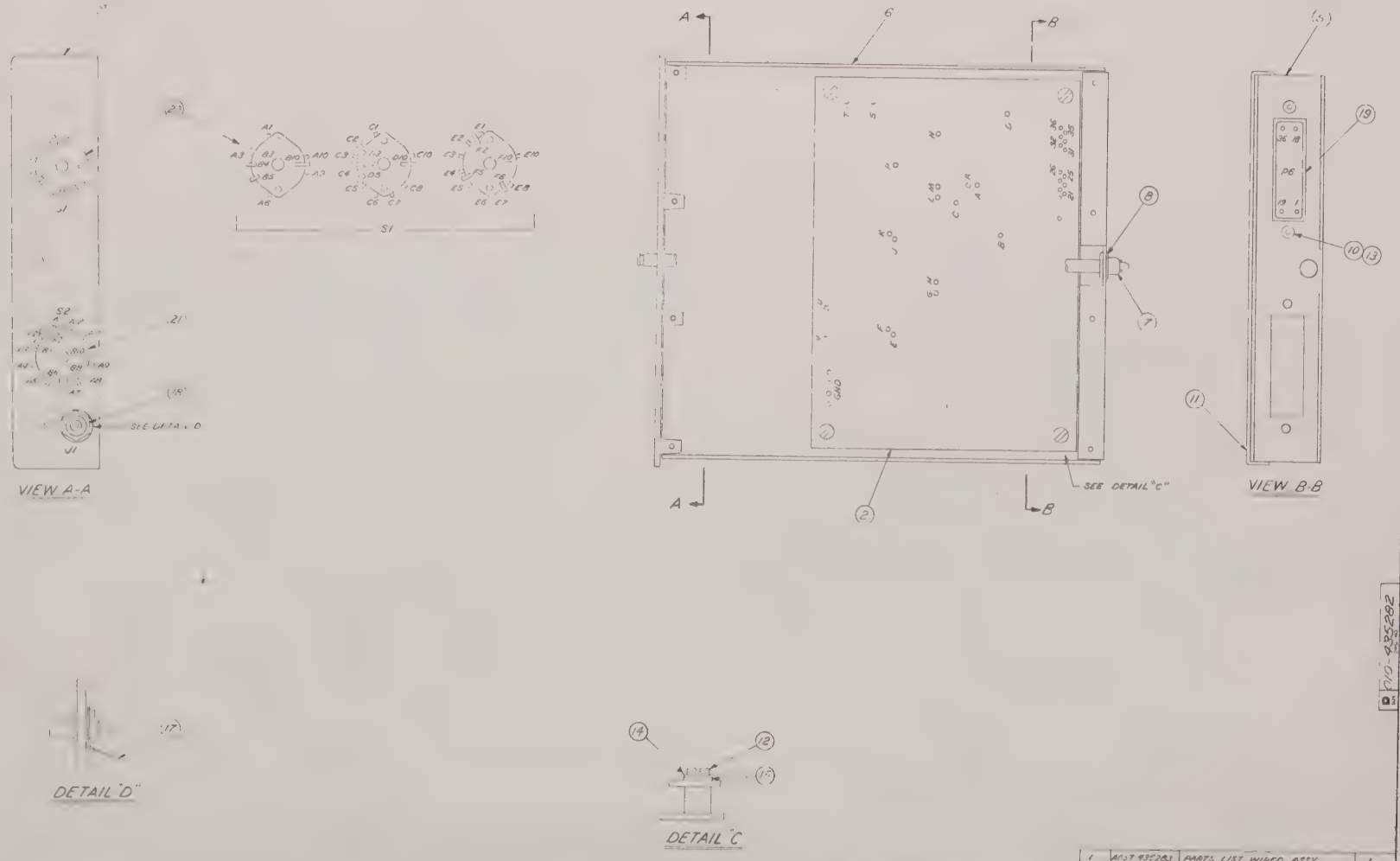
   * BECKMAN SPEC 4755 401 07
4. ⬡ — CONNECTIONS TO P. C. BOARD.
5. □ — CONNECTIONS TO P1.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SEE DETAIL D
S1
S2
J1
VIEW B-B
SEE DETAIL "C"
DETAIL "D"
DETAIL "C"
MECH & WIRED ASSY, 673 EPUT
PARTS LIST, WIRED ASSY
Beckman INSTRUMENTS, INC.
ELECTRONIC INSTRUMENTS DIVISION
D 010-435282 C
SCALE FULL
APPLICATION 673

MODEL 673 MECHANICAL AND WIRED ASSEMBLY PARTS LIST

NOTE: Items omitted are hardware.

Item No.	Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
2		*855-435190(C)	Printed Circuit Assembly	Beckman	1
3		433-435319	Front Panel	Beckman	1
5		433-435311	Rear Panel, Plug-In	Beckman	1
17		687-807233	Lug, Terminal	Centralab B16352	1
18	J1	670-854373	Connector, BNC, UG1094	Kings KC-79-35	1
19	P6	672-806769	Connector, 36-Pin, Male	Amphenol 57-10360	1
20	S1	711-435696	Switch, Rotary	Beckman	1
21	S2	711-435005	Switch, Rotary	Beckman	1

*P/L: A435283(B)

QTY	REV	ITEM	DESCRIPTION	ECO No	DATE	BY	CHK'D	APP'D
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	D		ADD DD, EE, FF & GG.	12075	2/4/68	[illegible]	L.W.	[illegible]

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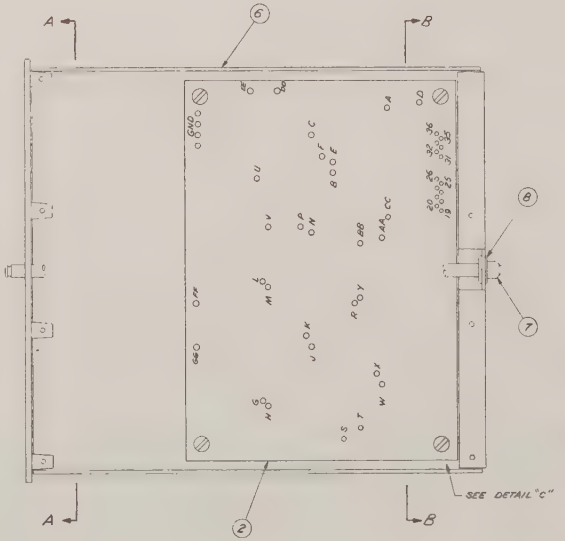

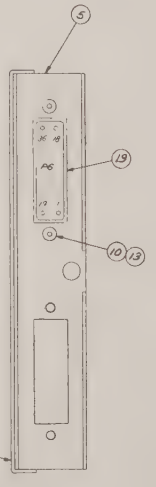

VIEW B-B

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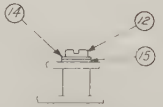


DETAIL C

D10-435376

1037 435377	PARTS LIST, WIRED ASS'Y		1
PART NO	DESCRIPTION		QTY

0997 435270	675	MECH & WIRED ASS'Y, 675 BUCAT	D
PART NO	MODEL NO		SIZE
APPLICATION		FULL	

Beckman INSTRUMENTS INC
ELECTRONIC INSTRUMENTS DIVISION

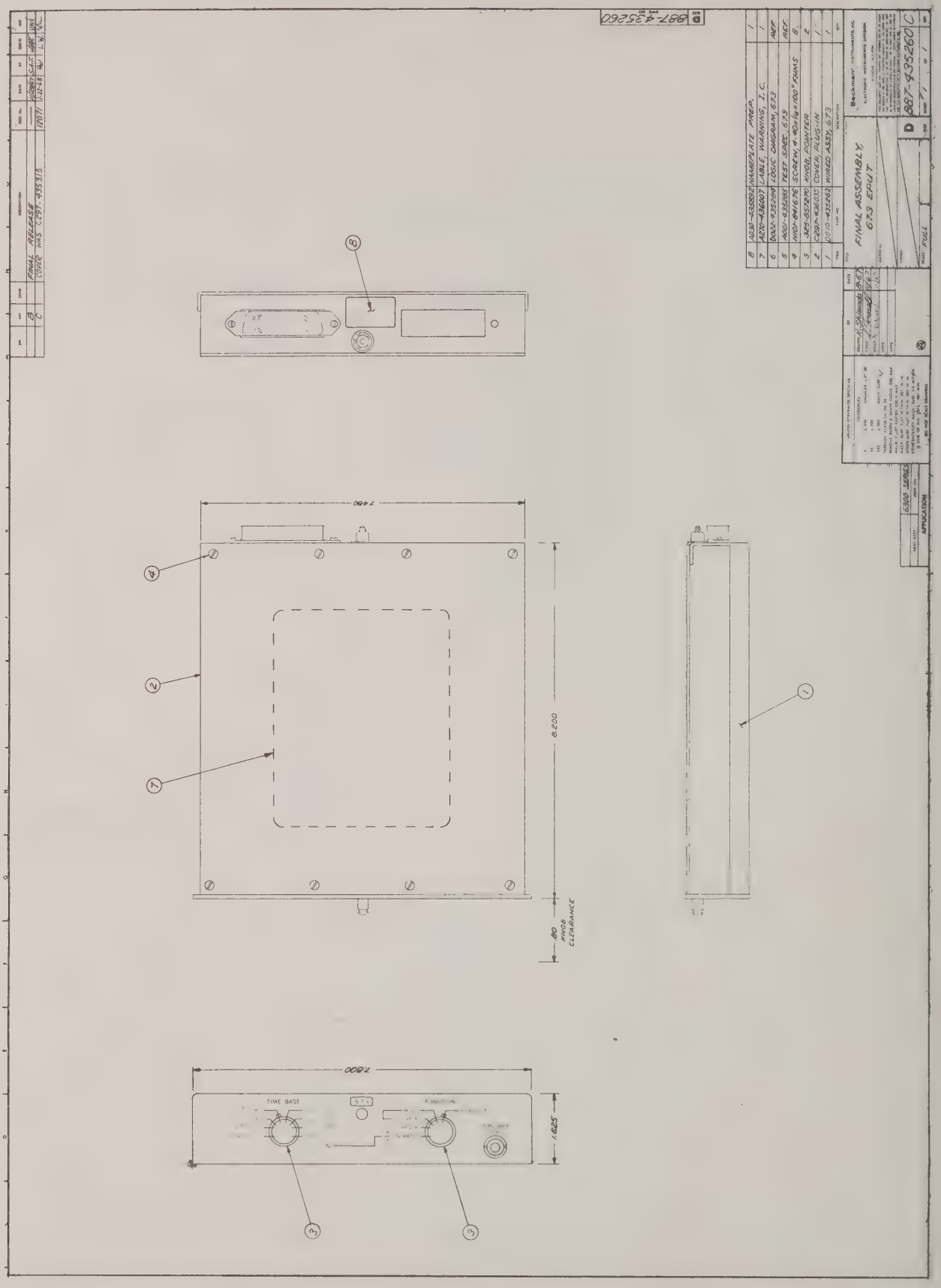
010-435376 D

SHEET 1 OF 1

MODEL 675 MECHANICAL AND WIRED ASSEMBLY PARTS LIST

NOTE: Items omitted are hardware.

Item No.	Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
2		*855-435220(B)	Printed Circuit Assembly	Beckman	1
3		433-435321	Front Panel	Beckman	1
5		433-435311	Rear Panel, Plug-In	Beckman	1
17		687-807233	Lug, Terminal	Centralab B16352	1
18	J1	670-854373	Connector, BNC, UG1094	Kings KC-79-35	1
19	P6	672-806769	Connector, 36-Pin, Male	Amphenol 57-10360	1
20	S1	711-435628	Switch, Rotary	Beckman	1
21	S2	711-435001	Switch, Rotary	Beckman	1


887-435260
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FINAL ASSEMBLY
673 EPUT
Beckman INSTRUMENTS, INC.
ELECTRONIC INSTRUMENTS DIVISION
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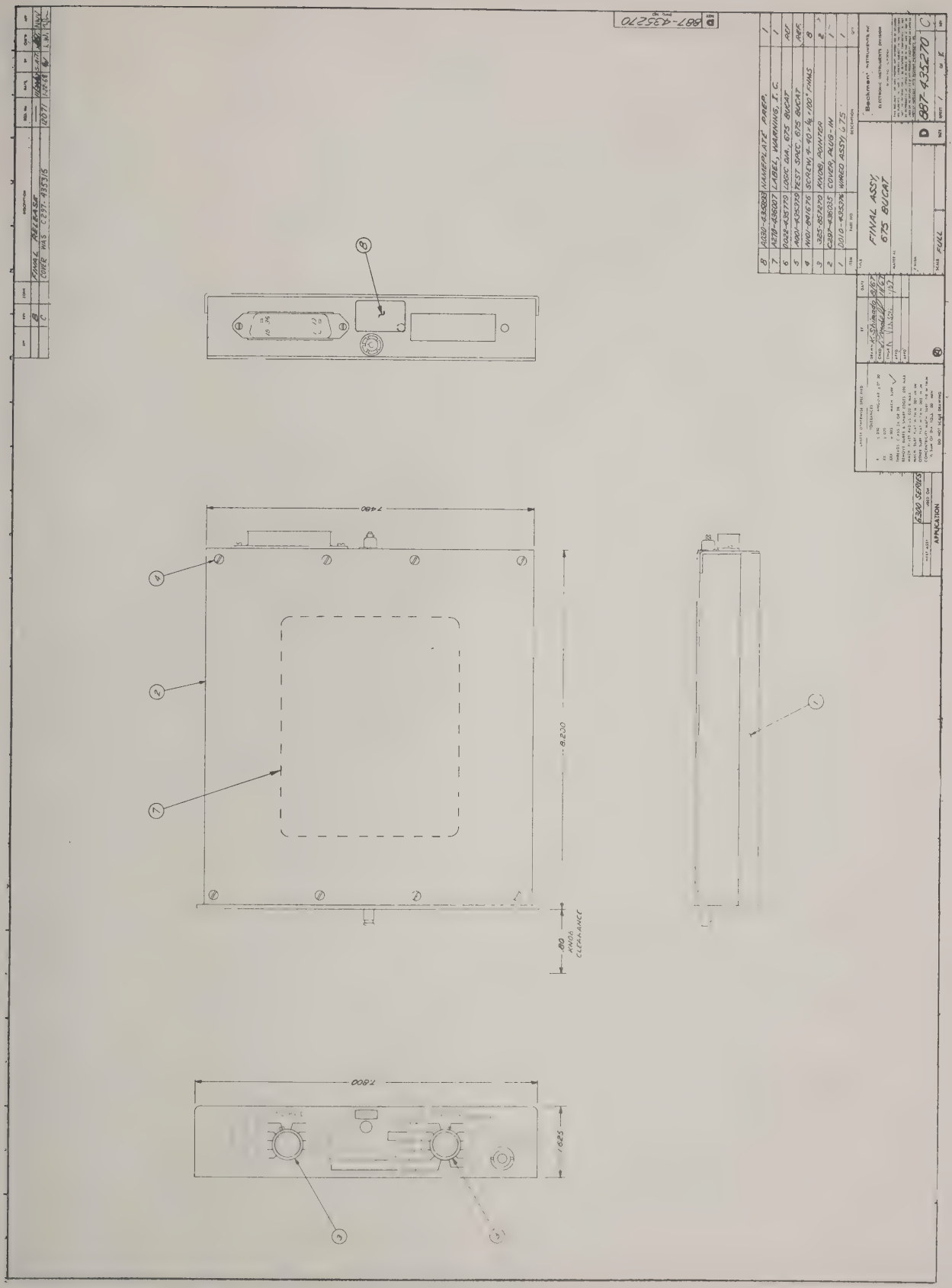
1.625
TIME BASE
FUNCTION


FINAL ASSY
675 BUCAT
D
987-4352701
7480
8200
80
7800
1625

Notes

BECKMAN INSTRUMENTS, INC.

Electronic Instruments Division

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Huntsville, Alabama 35801
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4306 Governor Drive
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205-837-6060

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Representative:

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44 E. Indian School Road, Suite 6
Scottsdale, Arizona 85251
602-947-7371

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3600 South Lincoln Street
Englewood, Colorado 80110
303-789-2203

FLORIDA

Representative:

Space Engineering
999 Woodrock Road,
Suite 300
Orlando, Florida 32803
305-841-2271

Factory Repair Facility is located at:
2200 Wright Avenue
Richmond, Calif. 94804
415-526-7730

ILLINOIS

E.I.D SALES & SERVICE

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312-583-1020

3900 River Road
Schiller Park, Illinois 60176
312-678-0050

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E.I.D. SALES & SERVICE

Route #1
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317-636-1478

KANSAS

Representative:

Impala, Inc.
6917 West 76th Street
Overland Park, Kansas
913-648-6901

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E.I.D. SALES & SERVICE

1830 York Road
Timonium, Maryland 21093
301-252-4810

MASSACHUSETTS

E.I.D. SALES & SERVICE

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Wakefield, Massachusetts 01880
617-245-6800

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E.I.D. SALES & SERVICE

25511 Southfield Road
Southfield, Michigan 48075
313-353-7900

MINNESOTA

Representative:

Charles E. Bohlig Co.
P.O. Box 8095
Minneapolis, Minnesota 55416
612-922-7011

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E.I.D SALES & SERVICE

5461 Highland Park Drive
St. Louis, Missouri 63110
314-371-5900

6016 Troost Avenue, Rm. 202
Kansas City, Missouri 64110
314-371-5900

Representative:

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